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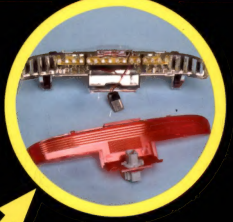

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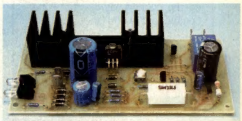

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PUBLISHER'S LETTER

LED lighting for cars – it's about time

This month we feature a major article on using high brightness LEDs in cars. We have wanted to do this for some time but it is only recently that really bright LEDs have become available at reasonably cheap prices.

In this article, we have majored on the Centre High Mount Stop Lamp (CHMSL) and stop lights, plus the so-called festoon lamps used for vehicle interiors. We would have liked to have taken the concept much further but you have to stop somewhere if you are ever going to publish. Fairly obviously, the bayonet lamp assembly could be modified to make a bayonet stop/tail light assembly and the smaller festoon LED assembly could be fitted with high-brightness amber LEDs to be fitted into traffic indicator repeater lights on the sides of cars.

However, the broad thrust of the article is rear end collision avoidance. The extra stopping time given by LED stop lights could mean the difference between a severe collision with major damage and injuries and maybe no accident at all - just some fevered breathing afterwards. If you do nothing else, you probably should convert your own car's centre high mount stop lamp to LED operation – it could save a life.

Victoria to stop DIY mains wiring?

This issue just won't go away. A recent issue of the Melbourne Herald-Sun notes that *"Electrical goods such as cabling, power points and safety switches will be banned from public sale under proposals to be presented to the State Government this week."*

"Electricians, tired of having their lives endangered by "dodgy" cabling installed illegally by home handymen, have called for a new code of practice that would restrict the sale of cabling and switches to licensed operators".

In fact, the proposed code of practice is already part of a new Enterprise Agreement between the Victorian branch of the ETU and the National Electrical Contractors association. Isn't that nice and cosy? This has nothing to do with safety.

Electricians aren't in danger from DIY wiring. Check the website of the Office of Chief Inspector: **www.ocei.vic.gov.au** and click on "incidents". Not only does it show that fatalities over the last 10 years have been very low, it also shows that members of the public have very low fatalities. We doubt whether any electrician has ever been killed by DIY wiring. If an electrician is in danger, he shouldn't be practising – he is not competent.

In fact, I have seen plenty of dodgy wiring done by licensed contractors installing kitchens, dishwashers, air-conditioners and hot-water systems. DIY wiring is not a safety issue. In fact, if sales of cables, switches, etc are banned, safety will be prejudiced. Whereas before, if a power point or wall switch failed, the competent handyman would just replace it, now it is likely to be left in an unsafe state. And if an appliance cord frays, it will be left unsafe; if you can't buy the cord, you can't do the repair.

And will all lighting stores close their doors? After all, most light fittings are fitted by home handymen, aren't they? So if you have been quietly and happily doing your own 240VAC wiring up till now, you can forget it. We did mount a campaign to make it legal but apathy got in the way. Once again, if you're not happy about this revolting development, contact your local MP and make a lot of noise.

Finally, in an encouraging development, a group is being formed in Queensland to have the Electrical Safety Act changed or repealed. If you are a technician repairing anything from air-conditioners to sewing machines, computers or anything else powered by 240VAC, contact the AETA (All Electronic Technicians Association) by fax on 07 4093 9700 or email: **cairnscomms@iprimus.com.au**

Leo Simpson

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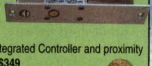

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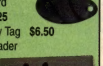

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MAILBAG

Motherboard for a silent PC

I have a brief response to the query by Peter Humphreys, in Mailbag, October 2002 issue, for a silent personal computer. VIA make a fanless motherboard – the web address is:
http://www.via.com.tw/en/Digital%20Library/pr_luckystar.jsp

To ensure complete quietness, a linear power supply would be required as well.

Geoff Perrin,
via email.

Nokia Datasuite is great

After "bagging" Nokia in these columns some time ago for being unable to produce a decent comms suite at a reasonable price to go with their phones, I thought I must set the record straight now.

I have just purchased their latest CDMA offering, the "6385" and I must say I am impressed with the connectivity offered now. Everything works as expected, including infrared linkup with current versions of Windows. What's more, the software is available free to download from their website. And to top it all, all the gadgetry, including car kits from the 5100 and 6100 series can be used as well. Good one, Mr Nokia.

Horst Leykam, via email.

Multi-sport scoreboard wanted

After spending a winter struggling with rusty steel number plates hanging on bent nails (Footy scoreboard), I started dreaming about an electronic scoreboard. Suddenly, it was cricket season – back to the drawing board! So how about a multi-sport scoreboard project ?

Many features are common to all sports but a modular approach would allow it to be configured to suit. Features needed would include large character displays, optional multiple displays, programmable control unit, timer/clock function, IR remote control and team ID display.

There must be thousands of sporting clubs: cricket, soccer, footy, bowls, etc all with this need but which cannot afford a commercial unit. You could start with a single-character display with a simple rotary switch.

Martyn Davison,
Paynesville, Vic.

Comment: how about it readers? Get your thinking caps on.

Shamrock monitors not popular

I read Serviceman's Log in the December 2002 issue with some bad memories of the same situation I was in with a Shamrock monitor. A lot of the older computer monitors use Shamrock circuits. We had a few waiting for the scrap heap. I emailed the company that made these boards and asked if we could acquire a circuit diagram in Australia. They responded with "No, we do not give out circuit diagrams"!

I could not believe this response. I work at a TV station and we can usually source a diagram for just about anything, either from the manufacturer or good ol' High Country Service. Needless to say these monitors did go to the scrap heap and we have not bought anything with their logo on it again!

Jamie Marschke,
Coffs Harbour, NSW.

Out-of-date website

Could you tell me why your website is so out of date? I went there recently for information on the December 2002 issue and the "current issue" displayed on the opening page was July 2002. Hardly current!

Can't you guys spend a bit of time and fix it? You refer readers to the site for software and PC boards and so on but that's not much use if we have to wait months for them.

J. S., via email.

Comment: the ***www.siliconchip.com.au*** *website is updated at least once a month, usually just after the issue goes to the press. Where necessary, (eg, to repair faulty links, etc), updates are done even more regularly. Because our website is operated "in house" we can make changes almost immediately.*

We get this "out of date" comment quite regularly and invariably when we contact the writer, he or she doesn't realise their computer is caching websites – not just ours but every one they visit. Or even worse, the person has installed web "go-fast" software which often does the same thing (but worse).

The answer is simply to hit your browser's refresh button on a regular basis. Having said that, we do appreciate feedback if you do find an error, broken link, etc.

Queensland licences in the police state

Welcome to police state, Queensland. I waded through the many pages of officialspeak on **www.eso.qld.gov.au** as referred to in the Publisher's Letters on January and February 2003. I did confirm that mere mortals, ie, non electrical workers, are still allowed to insert or remove 3-pin plugs and replace faulty light globes. Other than that, I am at a loss to understand if they have really changed. I have a restricted licence that allows me to work on medical and electronic equipment.

Last week, I assisted a licenced electrical contractor with the repair of a portable compressor with a capacitor-start/capacitor-run single phase motor. He had absolutely no idea what function the capacitors filled, apart from "they help the motor start". He was unable to test the capacitors for low capacitance or leakage and had no idea what sort of capacitor to get to replace the one that proved faulty. This is not only sad but downright scary.

I have worked in radio (including high-powered transmitters), the power

generation industry and in medical electronics; most of this experience was overseas. According to the Queensland electrical authority though, I am not competent to fit a 3-pin plug onto a portable appliance. What does a qualified person like myself do in Queensland? Drive a taxi?

This makes me seriously consider returning overseas where technical expertise can actually gain you employment. All this Labor Party sloganeering about "clever country" and "Queensland-Smart State" is totally the reverse of the legislation we get saddled with. It is no wonder that countries with more intelligent governments regularly outperform Australia.

Keith Johnson,
Brisbane, Qld.

Schools caught in the legislation as well

I run my own consultancy business (The Computer Bloke) as well as being the sole IT/Network administrator/PC support at a northern Gold Coast private college.

As a result of the Publisher's Letter in the January 2003 issue, I downloaded the legislation, amendments and other forms from the ESO website and started reading. I very quickly dismissed my first impression of the editorial as a silly New Year joke and now suspect this is actually a case of farcical stupidity on behalf of the Queensland Government.

As a computer consultant/repair person running my own business, I am breaking some law every time I open a PC case (Section 18(1)) to work on any components. Yet, as the IT/network administrator of a private school, using the same tools, doing the same tasks, on the same equipment, the work I do is quite legal. Or am I missing some arcane point? That is, the *school* needs to be licenced as an electrical contractor.

The implications of such a proposal are too monstrous to consider when the entire education system, both public and private, repair their own PCs. But then again, that can't happen, as I am my own supervisor, and according to Section 41(1) (c) (amended) need to be personally licenced.

This draconian legislation will not further the notion of "the smart state" as frequently proposed by the Premier. Smart businesses will move south, others will close their doors, all to the detriment of the state and ordinary Queenslanders. This legislation will not save any extra lives. Education and training will.

Although it would be presumptuous to think any revenue raised as a result of the licence fees would be used for such a purpose, there can be no other justification for this legislation. Personally, I can't see that happening. I'm now seriously considering moving back to Australia.

Kris Zalkalns, MCSE,
via email.

Repairers going out of business

I am writing in response to Paul Betterige's letter in the February 2003 issue. Paul seems to have confused the issue of being qualified to work in the electrical industry as a tradesman or technician, and being allowed to by virtue of buying, at some expense, membership of the Contractors' Club. The point being, in Queensland at least, that if you are not a member of the club then you cannot carry out the business of electrical work.

The membership of the Contractors Club has recently been dressed up in quasi-safety and consumer protection terms however the basic issue was that Contractors felt that there were too many people 'back-yarding' and competing 'unfairly' because they did not have the overheads of larger businesses. This was spelled out to me by an employee of the Electrical Safety Office early in the 'consultation' process. Just by the way, I don't see TETIA or TESA complaining about the issue . . .

I have operated as an electronics repairer employing at one stage three technicians in a Queensland country town. I had $10M public liability insurance, $30K of insurance on customers goods (2 - 3 times the average level of items under my control), Workers Compensation Insurance, Fire Insurance, Flood Insurance, Motor Vehicle Insurance, Electrical Workers Licences and all sorts of other guff to carry on business.

On top of that, were I still in busi-

The Tiger comes to Australia

The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

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ness, I would now have to greatly increase my insurance levels (the ESO seems to feel that one size, large, fits all).

I gave up the unequal struggle against costs some five years ago and sold the business. My successor ran on until the end of last year. Faced with increasing his insurances to levels way out of proportion with the size of his turnover and paying for a Contractors' Licence he too has given up and shut down. By the way, I don't do repairs for anybody any more.

David Pennycuick,
via email.

An electrician's view

After reading the January editorial, I felt I would be letting myself and other electricians down if I didn't make an effort to state my case over both the implications that electricians are somehow working in collaboration with bureaucracy to force electronic repair businesses to shut up shop, and that technicians are smarter cookies than electricians.

I have been disappointed with the way your editorials have covered this licensing issue over the last couple of years, and fellow sparkies have agreed with me. You make a few unquantified statements regarding the impact of these requirements but it remains to be seen how things really pan out. Believe me, we are all in the same boat when it comes to having more and more rules, regulations, fees, charges and the rest imposed on us.

I sometimes think that Governments are trying to force small businesses out of existence with new and additional costs and requirements. But what the Government is requiring of electronic and appliance repair shops is what has been required of us in the electrical trade for years and the burden is increasing.

Peter Cairns, via email.

Quiescent current trimpot should be fail-safe

I am writing concerning the new SC480 power amplifier featured in the January & February 2003 issues. In regards to the trimpot (VR1) which sets the quiescent current of this and many other amplifier designs, there is no "safety valve" if this goes open-circuit. Fitting a fixed resistor of suitable value in parallel with the trimpot stops the output stage from having no control of quiescent current whatsoever, usually taking out a pair of output transistors, at least.

Commenting on the ETI480 in general, I've used it in many general purpose applications and never had it oscillate. Attention to proper earthing procedures and layout produces a very stable unit.

The ETI480 module can be run from ±63V to give much more grunt than originally designed (into 4Ω too!) with some tweaking and appropriately substituted devices. How's does the SC480 go on higher supplies? Yeah, I know, "you don't recommend it" but if you start from scratch with new devices, not reusing the old 2N3055s, why not?

Brad Sheargold,
via email.

Comment: VR1 is fail-safe. If the wiper goes open circuit or the pot itself goes open-circuit, Q7 is biased into full conduction. This drops the bias on the output transistors and reduces the output stage quiescent current to near zero. In fact, the same comment applies to the ETI480 circuit.

Stability is a relative thing – we'll bet that many of the ETI480 amps you thought were stable were in fact prone to parasitic oscillation at 10MHz or above – you just never observed it.

As you predict, there is no way we would recommend an increase in supply to the SC480. You will probably get away with it when driving resistive loads but as soon as you start driving complex loudspeaker loads, the output transistors will be taken far in excess of the SOAR ratings and you will pop 'em.

Don't use WD-40 on noisy volume controls

I refer to the "tip" on curing noisy volume controls in the "Ask SILICON CHIP" pages of the October 2002 issue, in which the writer is a proponent of the WD-40 school of electrical fix-alls. Spraying a highly flammable residual liquid in an area where there is a high likelihood of arcing switch contacts (ie, the back of an old pot) is a recipe for disaster. I have seen many efforts by WD-40 jockeys, spraying entire amplifier chassis, TV PC boards and my favourite, the mechanism of a VCR.

WD-40 is for loosening rusty nuts in the engine bay of Dad's Holden, not for electronic switch, wiper or pot cleaning. There are plenty of far superior products that spring to mind, the most useful being CRC2-26 which, by the way, is not flammable, non-damaging to plastic or rubber, doesn't attract dust and smells a lot nicer.

Please don't publish such "tips" as they only encourage people to squirt the wretched stuff into the innards of anything electronic that isn't working.

John, via email.

Move to stop DIY wiring

I thought I'd let you know that my "rights" are under threat once again. I read in the Sunday edition of the "Herald-Sun" (dated 26/1/03 on page 30) under the title of "Union Bid To Switch Off DIY" that the electrical union wants to outlaw the sale of power points, cabling and safety switches from public sale. Is this all they want to ban?

Below is a copy of the text as printed:

"Electrical goods such as cabling, power points and safety switches will be banned from public sale under proposals to be presented to the State Government this week.

Electricians, tired of having their lives endangered by "dodgy" cabling installed illegally by home handymen, have called for a new code of practice that would restrict the sale of cabling and switches to licensed operators.

Electrical Trades chief Dean Mighell said the proposed code of practice was already part of a new Enterprise Agreement between the Victorian branch of the ETU and the National Electrical Contractors association.

The Union has met with Victoria's chief electrical inspector and this week will seek support for the code from the State government.

Mr Mighell said electrical wholesalers and hardware stores which sold specialist electrical parts to the public

were ignoring their duty of care."

Is this another Labor government/union ploy to seal the closed shop approach on a protected industry? Are they so desperate for a dollar that they want to seal up the market place so we treat them as gods? That's what they will be when you phone them up and ask to have a faulty power point replaced. We will all be put into a queue depending on how much work we give them or are prepared to pay.

As a repairer of electrical/electronic equipment, I occasionally require items from these businesses to complete repairs. I use an assortment of parts which can only come from electrical wholesalers. Are they going to stop me from earning an honest dollar?

I don't advocate the illegal wiring of buildings but common sense must prevail when we look at the big picture.

Name supplied but withheld at writer's request.

Contractor licences in Queensland

Thank you for bringing to the Industry's attention the issue of 'Contractor Licensing' for appliance repairers, in the January 2003 Publisher's Letter. Our Association understands your concerns. There are many facets to this debate and I am sure it will divide opinion in Queensland as well as the rest of the Australian States!

Unfortunately, the Electronics Industry in Australia, both Manufacturing/Supply and the Service/Repair side has no single, united voice. The closest we ever came to a single voice was the Australian Council of Electronics Associations (ACEA) which, although still an entity, is in a state of limbo due to lack of unanimous support in the Service sector (and we had not even started on the manufacturing sector)!

Due to this lack of unanimity and the diversified nature of the industry, it is very difficult to access the opinion and input of the many people involved (and let us just talk about the Service Industry here). Thousands of Australians beaver away at repairs having absolutely no idea of what others are doing and what commonalities they share. The CETA Information List (CINLIST) has made some inroads into bringing these people into contact although it does suffer from the anonymity of a List Server.

In the issue of the introduction of Contractor Licensing for Repairers in Queensland, the case for this was put through the Queensland Electrical Safety Office as you are aware and, as you have commented in SILICON CHIP, was open for discussion for many months before the legislation was enacted. As a Trade Association, we at CETA (Certified Electronic Technicians Association) received very little comment on this issue even though we brought it to the attention of our members over the same long period.

I'm afraid that we can only blame ourselves for this appalling situation in the Electronics Industry and until we can learn to get on together and take a united approach to the obstacles and decisions that affect us, I'm afraid that things will only get worse, not better.

Martin Shepherd,
Executive Officer, CETA.

BBC still broadcasts shortwave

I was amazed to learn from the December 2002 article on receiving satellite TV that "the BBC no longer transmits on shortwave" as I listen to them almost every night. While it's true that they've cut back on shortwave in recent years, choosing to reach audiences via broadcast FM, AM or streaming Internet audio, they do broadcast comprehensively via shortwave. There's a listing at:

http://www.bbc.co.uk/worldservice/schedules/frequencies/index.shtml

I'm sure that shortwave enthusiasts are looking forward to the launch of DRM which promises high quality digital audio over shortwave. See **http://www.drm.org/** for more information and downloadable software for decoding.

Peter Marks, via email.

Degradation of CDs

I note with interest the comments of your correspondent, John Tingle, about the degradation of CDs from storage problems and other damage, in the January 2003 issue. Some years ago, it came to my attention that it was the top or non-reading side of discs which was more prone to damage.

In an effort to overcome deterioration from 'dulling', scratching and chipping of the reflective layer, I developed a self-adhesive label which covers the entire top side of the disc. Much work went into the design to come up with the right adhesive/stock combination to ensure that it was entirely inert and did no damage to the disc or degraded the sound or data quality in any way. As the labels are virtually non-removable, they also provide a bonus benefit of permanent security marking of any disc they are applied to. They have since been patented.

We sell hundreds of thousands per year into the video games and DVD hire industry but (not surprisingly) we cannot interest the record producers in them. What we do find astonishing is that music retailers are almost completely uninterested in stocking them, although they stock roadside protectors and scratch repair kits.

Our protective covers have been fitted to discs for the last 10 years and not one is showing any signs of degradation. The material also stops the disc from sticking to the leaves in CD storage folders, a problem we have found in that type of storage.

If any of your readers are interested in obtaining some covers, they are available from our web site at:

www.disc-over.com.au

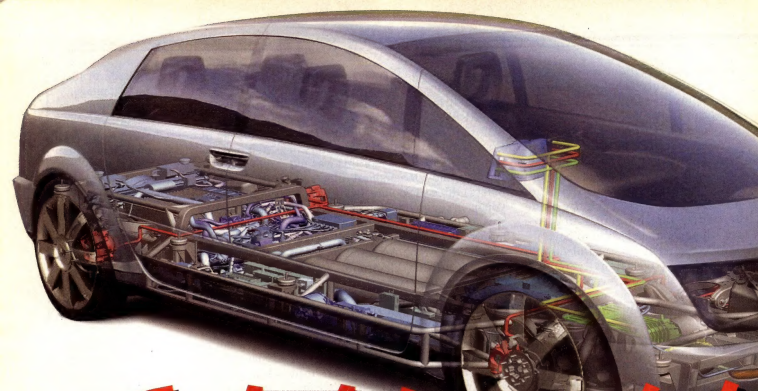
A. Bryan Fricker,
Managing Director, via email.

ABC radio delay explained

I noted the letter from a reader in the "Ask SILICON CHIP" pages of the January 2003 issue concerning the 1 to 2-second delay between ABC TV sound and ABC Radio on Parliament broadcasts. Your response attributed the delay to propagation delays through the possibly long path that the signal has to travel.

The delay is probably to do with the 2-second delay that talkback radio stations add to the transmitted signal. This is done so that the announcers have time to stop calls if they get abusive, without the abusive words being transmitted.

Shuni Francis, via email. SC



GM's Hy

The world's first drivable fue

General Motors has unveiled the Hy-wire concept car, the world's first drivable vehicle that combines a hydrogen fuel cell with by-wire technology.

The heart of the Hy-wire is an innovative "skateboard" chassis, which contains all of the sedan's propulsion, transmission, steering and braking components within its 279mm high frame and provides a single electrical connection to the body.

In essence, fuel cells enable a skateboard chassis and this flat plane provides unprecedented freedom for designing the vehicle body.

Complementing this, the by-wire systems allow a single docking connection between the skateboard chassis and the body, and this creates great opportunities for reinventing the interior layout.

Hy-wire was literally designed from the inside out, with form following function. The flexibility of the chassis accommodates multiple interchangeable "snap on" body styles that can be customised to meet customers' various lifestyles.

Fuel Cell Propulsion System

Inside, between the aluminium beams of the skateboard chassis, GM engineers have integrated an impressive technology package. A 3-phase electric motor, mounted transversely, drives the front wheels via a single-stage planetary gear with a transmission ratio of

8.67:. It generates a maximum power of 60kW and delivers a maximum torque of 215Nm. Maximum speed is 12,000 rpm.

The fuel cell stack consists of 200 single fuel cells connected in series and is roughly the size of a PC tower. It is located in the rear of the skateboard chassis and is cooled using a conventional radiator.

The stack, which operates under a pressure of 1.5-2.7 Bar, has a power density of 1.60kW/l and produces 94kW continuously, with a peak power of 129kW. This delivers between 125V and 200V DC, depending on the load. This is boosted to 250-380V and then converted to 3-phase AC to drive the electric motor.

Unlike other fuel cell vehicles, there is no battery in Hy-wire to provide extra power for peak loads. It uses only the fuel cell to provide power, thus simplifying the development and integration.

The fuel cells obtain the hydrogen fuel from tanks mounted securely in the centre of the skateboard. The three cylindrical compressed hydrogen storage tanks are made of carbon composite material, have a total weight of only 75kg and store a total of 2kg of gaseous hydrogen at 350 Bar.

Yes, you read that correctly – 350 Bar, about 5,000 pounds per square inch!

Incidentally, the next stage of development will increase the tank pressure from the current 350 Bar to 700 Bar.

GM and QUANTUM Fuel Systems Technologies Worldwide received certification from the top German safety institute for a 700 Bar (10,000 psi) hydrogen storage system that could ultimately allow fuel cell vehicles to drive 300 miles, depending on the storage volume.

Drive-By-Wire, Brake-By-Wire, Steer-By-Wire, Docking Connection

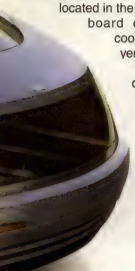
Developed by Swedish-based SKF, the "by-wire" technology enables all of Hy-wire's major driver-control functions, including steering, accelerator and brakes, to be consolidated into a flexible, hand-controlled unit called the X-drive.

It is similar to today's advanced aircraft controls, where commands are transmitted digitally from the cockpit through electrical cables, or "by wire", to the various parts of the plane.

Hy-wire uses the same technology, allowing the driver to easily control the vehicle with either the right or left hand from the X-drive unit. Drivers also have the option of driving from the left or right driving position because the X-drive is located in a centre console that shuttles from left to right.

Because it uses fully electronic connections and controls, the by-wire system simply plugs into the docking connections on the Hy-wire chassis.

At the heart of the by-wire system are



-wire

cell and "by-wire" vehicle.

smart electro-mechanical actuating units, which convert the driver's commands from electronic signals to motion. The by-wire system also provides dynamic feedback to the driver via electronic signals.

The advantages of by-wire technology in automobile applications include the elimination of steering columns and foot pedals and allows greater design freedom, simplified production of left and right-hand drive models and improved passive safety for the driver.

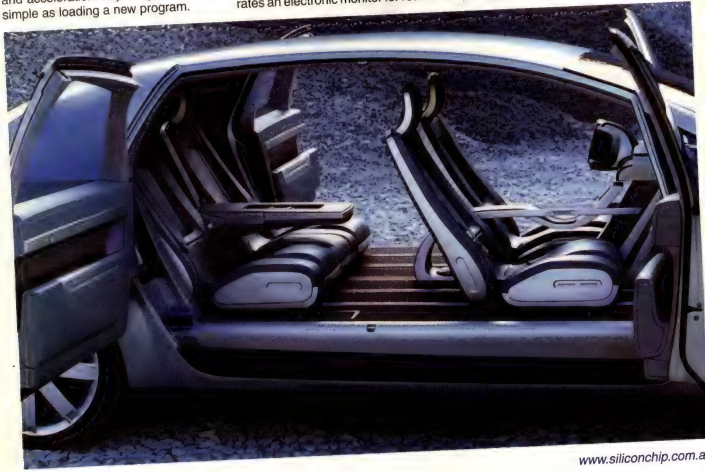
The elimination of mechanical and hydraulic linkages saves weight and simplifies maintenance because there are fewer moving parts that can wear out.

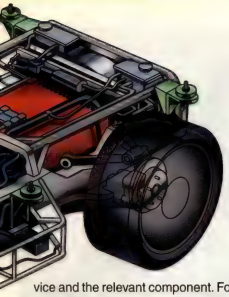
By-wire is more environmentally friendly because hydraulic fluids required for steering and braking are eliminated. Software allows the driver to personalise the handling characteristics of the vehicle by adjusting the feel of steering, braking and acceleration. Adjusting them is as simple as loading a new program.

The Hy-wire's X-Drive replaces the usual round steering wheel and pedals, giving drivers the option to brake and accelerate with either the right or left hand. The driver accelerates by gently twisting either the right or left handgrip and brakes by squeezing the handgrips. The handgrips glide up and down for steering, somewhat different than today's vehicles where the steering wheel revolves around a steering column.

The X-Drive also incorporates an electronic monitor for rear-view and vital car functions and shuttles easily from side-to-side on a horizontal bar that stretches across the full width of the vehicle.

The steering system highlights the basic functions of the by-wire controls. A conventional vehicle uses a direct mechanical or hydraulic connection between the driver's control de-





vice and the relevant component. For example, the commonly used rack-and-pinion steering system uses a small toothed wheel (the pinion) to engage the rack and to shift it left or right. Tie rods then carry the motion to the steering arms at the wheel.

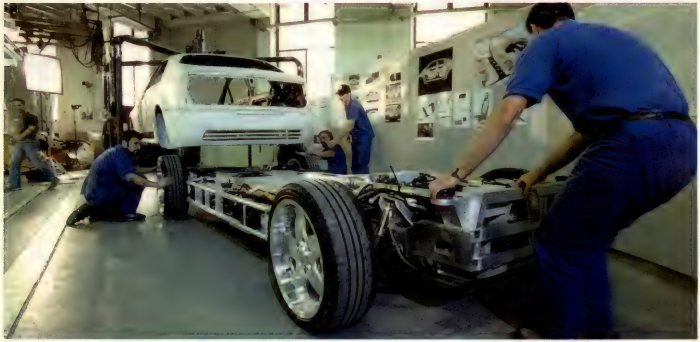
By-wire technology, in contrast, translates the driver's commands into electrical impulses. If the driver turns the handgrips of the X-Drive, sensors capture this motion digitally and send a signal to an electrical motor that moves the steering rack as instructed.

Acceleration is similar to the throttle on a motorcycle, except that a throttle cable does not mechanically activate the throttle valve of the power plant. The by-wire system transmits an electronic signal to the electric motor that drives the Hy-wire's front wheels.

Braking is achieved by squeezing either the left or right hand grip. Grip

Specifications: GM Hy-Wire

Vehicle:	Fuel cell and by-wire technology; front-wheel drive, luxury sedan
Seating capacity:	Five
Fuel storage system:	Three cylindrical high-pressure tanks of carbon composite material, mounted in the middle of the skateboard chassis
Length/diameter:	1,161/241mm
Total capacity:	2kg
Total weight:	75kg
Fuel cell stack:	200 single fuel cells; connected in a series
Voltage:	125-200 Volt
Length/width/height:	472/251/496 mm
Pressure:	1.5-2.7 Bar
Continuous rating:	94kW, peak of 129kW
Power density:	1.60 kW/l, 0.94 kW/kg
Electrical traction system:	3-phase asynchronous electric motor with integrated power electronics and planetary gear
Operating voltage:	250-380 Volt
Maximum rating:	60kW
Maximum torque:	215Nm
Maximum rpm:	12,000
Transmission ratio:	8.67:1
Total weight:	92kg
Skateboard chassis:	Length/width/height: 4,357/1,670/ 279mm Aluminium frame
Body:	Steel and fibreglass
Length:	5 metres
Vehicle weight:	1,900kg
Wheel base:	3,114mm



sensors determine how much hand pressure the driver is exerting and these transmit a signal which applies the brakes.

The system, developed together with the Italian specialist, Brembo, works with conventional brake calipers but responds faster.

Maximum reliability and safety are essential features of the data-transmission system in by-wire control. All safety systems have built-in redundancy and a back-up power supply similar to those used in fly-by-wire systems.

Body and Interior

Since Hy-wire's skateboard-like chassis contains all of the propulsion and control systems – a fuel cell and by-wire technology – designers were free to consider a number of body styles and interiors with what amounts to a fresh canvas to explore an endless range of possibilities for the body style and interior package.

GM wanted an obvious transition from where vehicle design is now to where the technology could take it and intentionally designed a vehicle that will highlight the openness in the interior and leave it to the occupant's imagination to consider the possibilities.

The break with conventional automobile architecture is obvious on the very first encounter with the car, which is 5-metres long, 1.87-metres wide and 1.57-metres high.

Glass is used extensively, giving passers-by a full view inside and the passengers a perfect view of the world outside.

The absence of a conventional engine means there is no need for a grille up front. So the question became what to do with the open front face where you'd typically put a grille. The designers chose to enclose it with glass, allowing the driver to have a view of the road ahead that has never been possible before.

You can see immediately that there is no engine at the front, the pedals and instrument panel are superfluous and the floor is flat from front to back.

Hy-wire features large side windows and no B-pillars (the traditional post between the front and rear windows). The rear doors are hinged at the back, allowing the four doors to open very wide, providing very easy access.

Anyone who accepts the invitation aboard can look forward to a comfortable and exciting journey. Apart from the unmatched panoramic view for the driver and passengers and spacious interior, Hy-wire offers several other key features.

The fuel cell and by-wire systems eliminate the need for a traditional engine bonnet and centre tunnel, resulting in improved legroom. The lack of foot pedals means the driver is not restricted to a specific leg position.

Flexibility

The X-Drive can slide across for left or right side driving, emphasizing Hy-wire's outstanding flexibility.

Pressing a button on the X-Drive starts the Hy-wire vehicle. Buttons also engage the vehicle's forward, reverse, and neutral drive conditions.

The X-Drive attaches to a very light and transparent-looking centre console. Integrated in this console is a second 15cm colour monitor which allows the driver to view radio controls, heating, ventilation, air conditioning and navigation systems.

The design team's work was characterised by a feeling of freedom – freedom, for example, to position the seats and control module where they wanted to, without any restrictions.

They paid particular attention to the seats when developing the Hy-wire's interior.

The five-passenger vehicle has front and rear bucket seats; the centre rear seat folds up to create a table.

Lightweight materials accentuate the vehicle's openness, and the overall environmental-friendly concept is expressed by the choice of natural colours.

The sporty yet elegant four-door vehicle has short overhangs, eight-spoke light-alloy wheels with 20-inch tyres in front, and 22-inch tyres in the rear.

Cameras have replaced the rear-view mirrors and the headlamps and tail-lamps feature LED technology. This technology allows the lamps to be packaged in a very small space. SC

Emergency beacons

Australia is a huge continent, surrounded by the vast Indian, Pacific and Southern oceans. If you get lost in the outback or have to abandon ship far out to sea, you could be in very serious trouble.

By PETER HOLTHAM

Twenty years ago you almost certainly would have been in trouble. Rescuers might have searched for days to find you – once they even knew you were overdue.

Today the Cospas-Sarsat satellite system, set up by Russia, Canada, France and the USA in 1982, takes much of the search out of search and rescue.

A constellation of satellites quickly detects signals from emergency radio beacons and alerts search and rescue authorities around the world. Since the system became fully operational in 1985, 29 other countries, including Australia, have become involved and more than 11,000 people have been rescued. Carrying an emergency beacon means you can be certain help will be on its way when you need it.

If you activate a beacon, it starts transmitting a low-power radio signal. Satellites in geostationary and low earth orbits pick up the signal and relay it to ground receiving stations, called Local User Terminals (LUTs). The LUTs locate the beacon position and pass it to Mission Control Centres (MCCs) which coordinate the search and rescue effort (Fig.1).

Beacons

Beacons come in many shapes and sizes. There are Emergency Locator Transmitters (ELTs) fitted in aircraft, Emergency Position Indicating Radio Beacons (EPIRBs) in ships, and hand-held Personal Locator Beacons (PLBs).

The oldest type of emergency beacon operates on 121.5MHz (Table 1). They were originally designed in the mid 1970s as ELTs for crashed aircraft. Nowadays there are about 600,000 low-cost EPIRBs and PLBs also using this technology worldwide.

Designed for detection by search aircraft not satellites, their simple analog signal doesn't tell the rescue authorities who or what is in trouble, or exactly where the emergency is. What is worse, only about three in 100 alerts worldwide are genuine.

Accidental or malicious activation, faults in the beacons, non-beacon transmissions on 121.5MHz, even 'hard' landings by aircraft with G-switch activated ELTs cause the rest.

But each alarm must be tracked to its source, wasting the time and resources of search and rescue teams. Because the false alarm rate is so high, Cospas-Sarsat will stop processing signals from these beacons after February 1st 2009, and they will be obsolete.

Newer beacons, specifically designed for detection and location by satellites, operate on 406MHz (Table 2). Frequencies in the

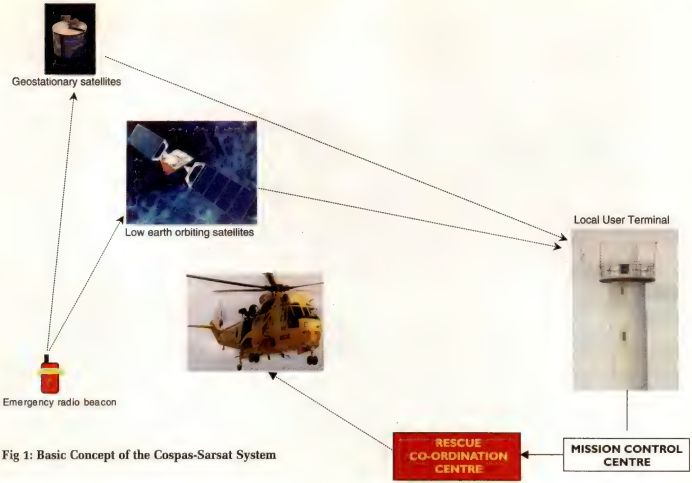


Fig 1: Basic Concept of the Cospas-Sarsat System

406-406.1MHz band are reserved solely for these beacons, which helps minimise the number of false alarms.

The beacons transmit a 5W burst of radio frequency (RF) every 50 seconds. The high power increases the chance of detection, while the low duty cycle saves power and allows more than 90 beacons to be operating at once in view of one satellite.

Each burst of RF carries a digitally encoded message, which identifies the owner of the beacon and its country of origin. Search and Rescue authorities worldwide keep a register of owners and can quickly make a phone call to check if an emergency is genuine or not.

Most 406MHz beacons also include a 121.5MHz transmitter and a flashing strobe light for search vessels to home in on during the last stages of a rescue. Second-generation beacons, available since 1997, add position data in the digital message, from an internal or external GPS receiver.

Because the performance of the Cospas-Sarsat system depends on the quality of the 406MHz beacons, manufacturers must get type-approval. Australian and New Zealand Standard AS4280 describes the rigorous durability tests a beacon must pass before it is approved for use. Only two Australian companies have gained type-approval for their beacons, and they manufacture them only for the Defence Forces.

Table 1: 121.5MHz beacon data

Transmitted power	50-100 mW peak effective radiated power relative to a quarter wave monopole
Transmision life	48 hours
Frequency	121.5MHz ±6kHz
Modulation type	AM (amplitude modulation), greater than 85%
Modulation	Swept audible tone, 300-1600Hz (at least 700 Hz) at a rate of 2-4Hz

Table 2: 406MHz beacon data

Transmitted power	5W ± 2dB
Transmission life	at least 24 hours at minimum temperature
Frequency	406.025 ±0.005MHz
Modulation	phase modulation, bi-phase L data encoding
Transmission time	440ms (short message) 520ms (long message)
Message length	112 bits (short) 144 bits (long)
Message repetition time	50s
Operating temperature	-40 to +55°C

Fig 2: Satellite in Polar Orbit Showing a Single Orbital Plane.

Inmarsat, the organisation responsible for worldwide ship-to-shore communication, also operates an EPIRB tracking system using satellites as part of its commitment to the safety of life at sea.

Inmarsat EPIRBs operate at 1.6GHz (Table 3). Like 406MHz beacons, they also transmit identification and GPS-derived position information. Some also have a 'will to live' feature – as soon as an Inmarsat land earth station (LES) receives an emergency signal, it bounces it back to the beacon. The beacon recognises its own code and shows a telltale visual indication. Survivors in the water can see that their distress signal has been received and that help is on the way.

Satellites

The Cospas-Sarsat system uses low-earth orbiting (LEOSAR) and geostationary (GEOSAR) satellites. The LEOSARs are in polar orbits 800-1000km above the Earth. They complete an orbit every 100 minutes or so, listening for both 121.5MHz and 406MHz beacons.

The system uses a minimum of four LEOSARs to speed up detection of activated beacons (Table 4). With a single satellite, it takes at most one half rotation of the Earth (twelve hours) for any location to pass under the orbital plane (Fig.2).

A second satellite with its orbital plane at right angles to the first reduces the time to six hours. Using four satellites ensures the time taken to detect a beacon is less than one hour at mid-latitudes and slightly longer nearer the equator where the LEOSARs are more spread out.

With 121.5MHz beacon signals, LEOSARs simply act as repeaters, relaying the signal to a LUT for processing. For an emergency beacon to be noticed, a LEOSAR has to be in view of the beacon and a LUT simultaneously for at least four minutes. If it is not, the emergency will be missed until a more suitable pass occurs, which can take several hours.

This constraint limits the use of these beacons to within a 3000km radius of the LUT (Fig.3).

Table 3: Inmarsat-E Beacon Data

Transmitted power	1W
Transmission life	48 hours minimum
Frequency	667 channels at 1.645GHz
Modulation	Frequency shift keying.

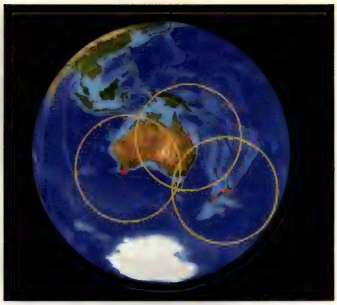


Fig 3: Approximate 121.5MHz Beacon Coverage from Australian and New Zealand LUTs.

Table 4: LEOSAR Satellites

Satellite	Spacecraft	Status
Cospas-6	Nadezda-3	Operational
Cospas-8	Nadezda-5	Operational
Cospas-9	Nadezda-6	Operational
Sarsat-4	NOAA-11	Operational
Sarsat-6	NOAA-14	Operational
Sarsat-7	NOAA-15	Operational
Sarsat-8	NOAA-16	Operational

Looking for all the world like the lighthouses of yesterday, Australia's two Local User Terminals (LUTs) are located at Albany, WA (left) and Bundaberg, Qld (right). The inset in the middle is an on-ground shot inside a LUT antenna dome.

Because LEOSARs were specifically designed to detect 406MHz beacons, they do more than just relay the signal. An on-board Search and Rescue Processor (SARP) decodes and time-stamps the beacon's digital signal and measures the Doppler shift (the change in frequency caused by the relative movement between the satellite and the beacon), locating the beacon to within 5km. In 95% of cases, the location is determined on the first orbit after detection.

Second generation 406MHz beacons transmitting GPS-derived position data can be located to within 120m.

In local mode, the satellites immediately transfer the information to the 1545MHz downlink, for transmission to any LUT that may be in view.

In global mode, the satellites also store the data in memory and continuously re-broadcast it on the downlink frequency. This means all LUTs tracking the satellite are able to locate the beacon, giving the system global coverage. There is no waiting until the satellite can see both the beacon and a LUT simultaneously, reducing the time taken to launch a rescue.

Data storage gives the LEOSARs global but not continuous coverage; there may still be a delay before a satellite comes into view. So the Cospas-Sarsat system also uses three geostationary satellites (GEOSARs) orbiting 36,000km above the equator (Table 5). These communications and weather satellites carry 406MHz beacon receivers as secondary payloads.

Table 5: GEOSAR Satellites

Satellite	Status
GOES-8	Operational 75° W
GOES-10	Operational 135° W
GOES-11	In orbit spare
INSAT-2B	Operational 93.5° E

GEOSARs provide a continuous watch and can send an alert as soon as a beacon is activated but there are some disadvantages. As GEOSARs are stationary relative to the Earth, there is no Doppler effect on the received signal to provide position information. Unless it is encoded in the digital message, LEOSARs must still be used for beacon location.

Hilly ground or other obstructions can also hide the GEOSARs from view, especially at high latitudes; neither can they cover the polar regions, latitudes greater than 75° (Fig.4). But even with this limitation, GEOSARS can see about 97% of the Earth's surface.

Four geostationary communication satellites spaced around the equator detect Inmarsat EPIRBs. Like GEOSARs, Inmarsat satellites cannot see the polar regions but this is not a major problem as very little commercial shipping enters these regions.

Local User Terminals (LUTs)

Local User Terminals are unmanned ground stations that receive the downlink signal from the orbiting LEOSARS as a 2400kbps data stream. They consist of an antenna, a 1545MHz receiver, a computer to process the data, and an MCC interface. The antenna and receiver automatically acquire, track and receive the downlink signal from all non-conflicting LEOSAR passes.

There are 45 LEOSAR LUTs worldwide (Fig.5). Two are in Australia, one on the east coast at Bundaberg and one on the west coast at Albany. New Zealand has one LUT, near Wellington, while to our north there are LUTs in Indonesia, Singapore and Guam. All LEOLUTs are expected to be available 24 hours a day, every day, with less than 5% downtime a year.

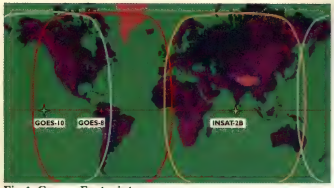


Fig 4: Geosar Footprints

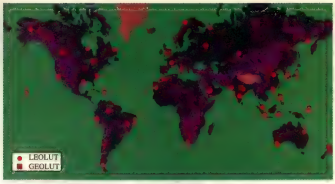


Fig 5: Worldwide location of Leoluts and Geoluts

Once a 121.5MHz beacon signal is received, the LUT roughly fixes its position from the Doppler shift. Initially two mirror-image positions are calculated, one on either side of the satellite ground track. It takes until the next orbit, 90 minutes later, to resolve the ambiguity and fix the position to within 20km.

The data from 406MHz beacons is simpler to deal with, since the Doppler shift is measured and time-tagged by the SARP onboard the LEOSAR. Within minutes of the satellite disappearing over the horizon, all stored data has been processed and passed to the nearest Mission Control Centre.

Another seven GEOLUTS worldwide receive and process alerts relayed by GEOSAR satellites (Fig.5). In the southern hemisphere, there are GEOLUTS in New Zealand and Chile. Separate Land Earth Stations (LES) operated by Inmarsat (including one in Perth) monitor the signals from the Inmarsat-E beacons.

Mission Control Centres (MCCs)

24 Mission Control Centres around the world receive alert and location data from LUTs, other MCCs and Inmarsat Land Earth Stations. Because a 406MHz emergency is usually processed by more than one LUT, the MCCs are networked together so that alerts can be rapidly sorted and passed to the nearest search and rescue team for action.

The MCC for the Australasian region is in Canberra and is operated by Australian Search and Rescue (AusSAR), part of the Australian Maritime Safety Authority. About 60 search and rescue specialists and support staff work in the Centre, which operates 24 hours a day, 365 days of the year.

As well as managing the Australasian segment of the Cospas-Sarsat system, AusSAR coordinates Australia's Search and Rescue Region. Covering 53 million square kilometres or one tenth of the Earth's surface, it includes the nation as well as vast areas of the Indian, Pacific and Southern Oceans.

The search and rescue teams coordinated by the Centre come from the private sector, the police, volunteer groups and the Defence Forces.

How long will it be before you're rescued once you've switched on your beacon? AusSAR has one of the best search and rescue response times in the world. During 2000-2001, it took an average of just 57 minutes to get a rescue underway after receiving an alert. But how long it takes to get to you will depend on where you are and whether there are ships or aircraft nearby.

But unlike 20 years ago, at least you can be certain that you will be found. **SC**

The GlobalFix 406 is the next generation of EPIRB featuring an internal GPS engine to add latitude/longitude coordinates to the emergency signal. It is available in either Category I (automatically deployable) or Category II (manually deployable) models. The beacon's self-test features include a thorough analysis of the GPS's circuitry (each time you self-test the EPIRB, the GPS is tested as well). When used in an emergency, the GlobalFix 406 will automatically change its operating "red" flash to "green", to confirm the exact time the GPS coordinates are received and re-broadcast in the EPIRB's transmission. (EPIRB pictures supplied by Tony Smith & John Bell, ACR Electronics Inc.)

Acknowledgement:
Thanks for the assistance of Ben Mitchell of AusSAR in preparing this feature.

Abbreviations

Cospas	**CO**smicheskaya **S**istyema **P**oiska **A**variynich **S**udov (Space system for the search of vessels in distress)
Sarsat	**S**earch and **R**escue **S**atellite **A**ided **T**racking
ELT	**E**mergency **L**ocator **T**ransmitter
EPIRB	**E**mergency **P**osition **I**ndicating **R**adio **B**eacon
LES	**L**and **E**arth **S**tation (Inmarsat)
LUT	**L**ocal **U**ser **T**erminal
MCC	**M**ission **C**ontrol **C**entre
PLB	**P**ersonal **L**ocator **B**eacon

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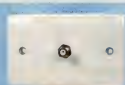

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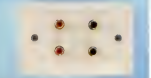

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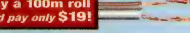

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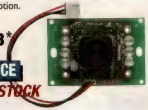

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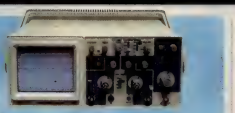

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Replace your car's filament lamps with LEDs for improved safety
By PETER SMITH

LED Lighting For Your Car

INCREDIBLY BRIGHT Light Emitting Diodes (LEDs) have recently become available in standard 5mm packages – bright enough, we believe, to rival incandescent bulbs in some applications.

This month, we present five simple and easy-to-build modules based on these new, ultra-bright LEDs. These modules can be used to replace or supplement a variety of existing automotive lights to improve safety.

Safer, huh?

Do you know why the centre high-mount stop lights of some vehicles use LEDs rather than conventional filament lamps? For the "high-tech" look, perhaps?

Maybe, but there's a much more important reason; LEDs reduce the incidence and severity of rear-end collisions!

So how is this possible? The answer is based on the fact that filament lamps typically take between 120ms and 250ms to 'light up' when you hit the brakes. If that doesn't sound like much, then consider the distance travelled in 200ms at 100km/h:

100km/h x 1/3600 x 200ms = 5.5m

Those 5.5 metres could make all the difference in an emergency braking situation – a serious accident or none at all!

The good news is that you can get that distance back with LED-based stop lamps, because LEDs 'light up' almost instantaneously. Not only that but the fast turn-on of LEDs makes them more conspicuous; they have greater attention-getting power.

LEDs have a number of other advantages over filament lamps, too. They load vehicle electrical systems by at least one third less, generate little heat, require less space and have a very long service life.

Convert These to LEDs

- High-mount stop lights
- Trailer lights
- Breakdown lights
- Clearance lights
- Interior (festoon) lights
- Bayonet lamps
- Wedge lamps
- Almost anything!

With all these positives, it seems ludicrous that most new vehicles aren't fitted with the latest high-brightness LED technology. Sure, you'll see them in high-end vehicles like the Jaguar and Maserati. Less-expensive vehicles, such as Holden's Monaro, use them in the centre high-mount stop light (CHMSL) but generally speaking, their use in tail, stop and turn indicators is not widespread.

We're ignoring spoiler-mounted CHMSLs here, by the way, because they're available only on a limited number of models and are usually optional.

As far as we can determine, the only reason for this apparent short sightedness is cost. And that, of course, is poised to change in the very near future, as LED prices come down (and intensities go up). But why wait? You can now convert your old-technology CHMSL to the latest and greatest with the aid of our LED CHMSL module and a few simple tools.

This particular module consists of a single, 150mm-long PC board strip carrying 16 high-intensity red LEDs, four resistors and two diodes. It should fit inside most CHMSL housings without too much difficulty, replacing the standard 21W filament lamp. But before we describe how that's done, let's take a look at how it works.

How the modules work.

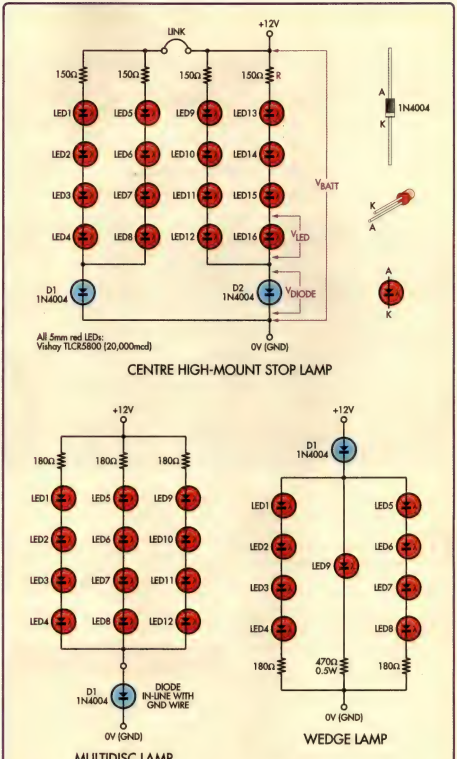
All modules are of the simplest design possible. They consist of one or more strings of LEDs, current limiting resistor(s) and in most cases a diode or two as well.

Referring to the circuit diagram for the CHMSL module (Fig.1), you can see than the LEDs are arranged in four strings. Each string consists of four LEDs in series with a current limiting resistor. The resistor sets the current through the string, as follows:

$I = V/R$
$= V_{BATT} - V_{DIODE} - (4 \times V_{LED}) / R$
$= 12.8V - 0.7V - (4 \times 2.0V) / 150\Omega$
$= 27.3mA$

V_{LED} is the forward voltage of the LEDs at the intended current, in our case about 27mA. This value will vary between LED types, so you may need to adjust your resistor values for optimum results.

Although the high-brightness red LEDs we've specified can be driven at much higher current levels (up to 50mA), we recommend derating to a maximum of 30mA to allow for the high temperatures found in automotive interiors. If you're using different LEDs, then derate even further to 25mA.



SC AUTOMOTIVE LED LAMP MODULES

Fig.1: circuit diagrams for all of the red LED modules. Note that we've reduced LED current on the Multidisc and Wedge lamp modules by increasing the resistor values from 150Ω to 180Ω. This is to allow for the higher temperatures present in tightly grouped LED arrays.

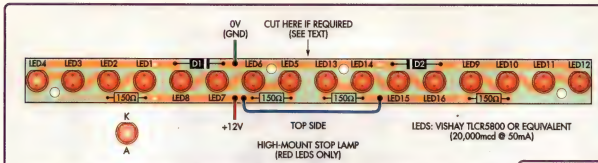
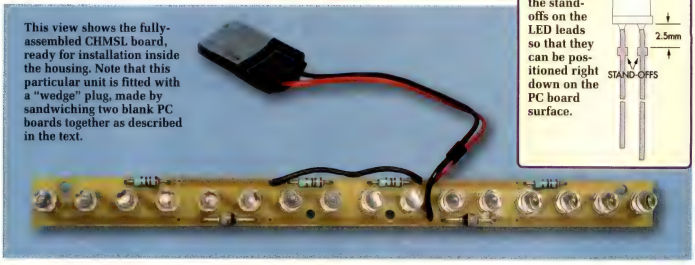


Fig.2: follow this diagram when assembling your centre high-mount stop lamp board.



This view shows the fully-assembled CHMSL board, ready for installation inside the housing. Note that this particular unit is fitted with a "wedge" plug, made by sandwiching two blank PC boards together as described in the text.

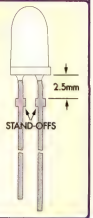


Fig.3: you may need to trim away the stand-offs on the LED leads so that they can be positioned right down on the PC board surface.

V_{DIODE} is the forward voltage of the 1N4004 diode. The purpose of this diode is to protect the LEDs from the large negative voltage transients (up to 400V) often present in automotive electrical systems.

Typical LED reverse breakdown voltage is somewhere in the region of 5-6V, so with four LEDs in series the best we could hope to "stand off" without the additional diode would be about 24V.

In cases where there are less than three LEDs in a string, the 1N4004 also provides reverse polarity protection. Without protection, accidental lead reversal could cause your megabuck LED bank to glow brighter than the Sun for a few milliseconds!

An example

OK, let's look at an example. Suppose you're using different LEDs to those shown in the parts list and you've determined that they drop about 1.8V at 25mA (the forward voltage can be determined from the LED data sheets or by trial and error). What value resistors would you use on the CHMSL module?

$$R = V/I$$
$$= 12.8V - 0.7V - (4 \times 1.8V) / 25mA$$
$$= 196\Omega$$

The closest readily available value to 196Ω is 200Ω, so that would be your final choice. A 0.25W power rating is sufficient in most cases.

So far, we've only talked about the CHMSL module but there is little difference in operation between the five modules. Some have less LEDs per string, some have just one (the 10mm LED on the wedge lamp, for example) and one requires the diode to be fitted externally.

Note, however, that we've listed LED colours with each module. This is because white and blue LEDs have a significantly higher forward voltage than red (and other colours) and therefore will not work on modules that have four LEDs in series.

Likewise, reds (and other colours) cannot easily be used on the modules specified for white and blue without considering the increased resistor power dissipation requirements.

WARNING

If you have a late-model car, it may have a lamp failure detector in the brake lamp circuit. If you convert just the CHMSL to LED operation, it is unlikely to be affected. However, if you also convert the stop lamps to LED operation, the lamp failure detector will almost certainly operate each time you press the brake pedal. The fault may even be recorded in the computer's diagnostic memory.

In some prestige cars, such as the Lexus LS400 and LS430 models, the CHMSL also has a lamp failure detector and it will "detect" a lamp failure if the LED conversion is present. At present, we have no solution for this problem.

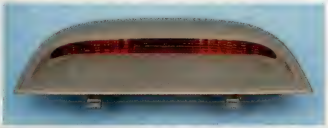
CHMSL module assembly

Referring to the overlay diagram in Fig.2, begin by installing the two diodes and four resistors. Take care with diode orientation, noting that D1 and D2 go in different ways around.

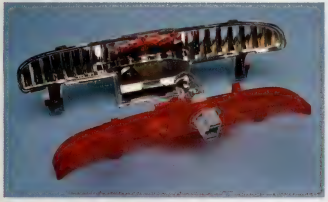
Next, install all 16 LEDs, aligning the side with the 'flat' (the cathode) as indicated. This should also be the side with the shorter lead. We mention this because the 10mm LEDs we re-

Converting A High-Mount Stop Light To LEDs

Fitting the CHMSL module (shown at left) to an existing housing can be achieved with a little ingenuity. Here's how we did the job on a late-model Honda Accord.



(1). The Accord's CHMSL sits on the parcel shelf and is retained with two clips accessible from within the boot space. The entire assembly came away in less than 10 seconds!



(2). Once we had the assembly on the bench, it was a simple matter to separate the red lens from the reflector to get to the insides. Be careful with the clips that hold these parts together, as the plastic is very brittle.

(3). In our case, the replacement LED module was just the right length for the job. We made a couple of small right-angle brackets to hold the board and screwed these to the top of the reflector. Many other mounting methods are possible, depending on shape and available space; eg, nylon stand-offs, cable ties, M2.5 screws, neutral cure silicone sealant, etc. Make sure that the rear of the PC board cannot contact anything metallic, though.

(4). We didn't want to modify the vehicle's wiring, so we powered the LED module directly from the old filament lamp socket. A suitable plug can be fashioned from two pieces of PC board, some glue and a length of tinned copper wire (see wedge lamp details). Be sure to tin all bare copper areas to prevent corrosion.

ceived recently were incorrectly polarised; the flat side was next to the anode (longer lead). If you're not sure, use your multimeter on "diode test" to verify polarity.

The LEDs should be seated right down on the PC board surface. Some LEDs have large standoffs formed into their leads, making this impossible. If you have this problem, then measure between the underside of the LED and the start of the standoffs (see Fig.3). If you measure 2.5mm or more, then you can cut the leads off right at the edge of the standoffs, as there will be sufficient length remaining for soldering. Try just one LED first, though!

If the standoffs are closer than 2.5mm to the body, then shorten the leads to about 4mm and using a fine-edged pair of electronics sidecutters, carefully snip away the shoulders of the standoffs (see Fig.3).

To finish, install the +12V link and two 150mm flying leads for the +12V and 0V connections. Any light duty multi-strand hook-up wire will do.

CHMSL module installation

We chose a late model Honda Accord for our prototype installation – see photos. We didn't hack off any "unnecessary" bits along the way, thus allowing return to the standard filament lamp configuration if need be. Adapt our methods to suit your particular vehicle.

If the module is too long for your housing but there is plenty of vertical space, then you can cut it in half and mount one section directly above the other. This is possible because we've designed the two sides of the board in "mirror image". These smaller sections could be useful for other applications as well.

Multidisc module assembly

As the name suggests, the Multidisc module has multiple uses, some of which will require the PC board to be

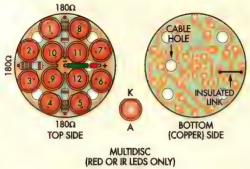


Fig.4: the overlay diagram for the Multidisc module. Form the leads of each resistor so that its body sits directly between adjacent LEDs.

circular in shape. Manufacturers will probably supply this PC board as a square, so if you need it to be round, now is a good time to cut and/or file it to shape.

That done, install the LEDs, aligning all cathodes (flat sides) towards the centre of the board. The LEDs must be mounted right down on the PC board surface. If your LEDs have large standoffs that prevent this, then refer to the assembly instructions for the CHMSL module for the solution.

Install the three resistors next. Now turn the board over to the copper side and install an insulated wire link as shown on the overlay diagram (Fig.4). Finally, solder two lengths of light duty hook-up wire to the +12V (+) and 0V (-) points and pass the ends through the cable hole.

Unlike the other modules, this one doesn't have a diode in series with the supply. We recommend installing a 1N4004 diode in series with either the positive or negative lead and insulating it with heatshrink tubing.

Bayonet lamp assembly

Below are the instructions for the bayonet lamp assembly, presented in a step-by-step format to help make the job easier – see Figs.5 & 6.

(1). Remove the glass bulb and filament from a standard 21W automotive bayonet lamp. Clean the glue from around rim of base and several millimetres into the interior. Polish the area with a fine scouring pad or ink rubber and clean with alcohol.

(2). Remove solder from the tip.

(3). Cut a standard 14.5mm O.D. copper water pipe joiner in half and chamfer one end with a file. Polish the tube with a fine scouring pad or ink rubber and clean with alcohol. Insert the tube 2-3mm into the base rim and solder in place.

(4). Centre the Platform PC board over the end of the tube and solder in place. Apply your iron to the copper tube rather than the PC board so as not to overheat the latter.

(5). Trial fit an assembled Multidisc module on the Platform board to determine the required lead length. Trim the +12V wire to length and strip and tin the end. Pass it through the centre hole in the Platform board and solder it to the base tip, building up the solder as needed to get a nicely curved "bump".

(6). Pass the 0V (GND) wire through the outer board hole and trim to 10-15mm in length. Stip and tin the end.

(7). Trim both leads of a 1N4004 diode to about 6mm in length and solder the anode end to the 0V (GND) wire. Slip a length of heatshrink tubing over the diode to insulate the connection. Solder the other (cathode) end of the diode to the underside of the Platform PC board.

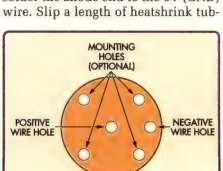


Fig.5: the Platform PC board is unetched (blank copper). To make one, cut the 26.5mm disc from blank circuit board material and drill six 2.5mm holes as show here. The Multidisc PC board can be used as a template.

(8). Attach the Multidisc assembly to the Platform board using small cable ties, or for a more permanent job, use several 'blobs' of neutral cure silicone sealant.

Wedge lamp "skeleton" assembly (Fig.7)

(1). Prepare the blank (non-copper) sides of two wedge PC boards so that all edges are free of burrs and the surfaces are completely smooth and clean.

(2). Bond the blank sides together (copper sides facing out) using a very thin smear of cyanoacrylate-based adhesive. Pay particular attention to alignment; the boards must be exactly aligned, such that they appear to be one single unit after bonding.

(3). Touch up the sides with a fine jewellers file to bring the edges into perfect alignment. Also, file the shoulders if necessary to ensure that they are horizontal and in line.

(4). Trial fit the assembly to a wedge lamp socket. A small chamfer on the leading edges of the wedge assembly may make insertion easier.

(5). As supplied, the Disc PC board may have a series of three holes rather than a slot in the middle. You'll need to file a slot that is just large enough to accept the head of the wedge assembly. Make the fit as firm as possible. You may also need to cut and/or file the board outline into a circular shape, as some manufacturers will undoubtedly supply it as a square.

(6). Assemble the boards, making

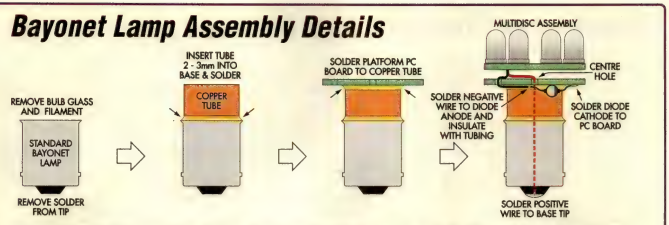


Fig.6: follow this diagram and the step-by-step instructions in the text to make the Bayonet lamp assembly. The Multidisc assembly can be fixed in place with neutral cure silicone sealant.

sure that the shoulders of the wedge assembly firmly contact the underside of the Disc board. Solder the three pads on the wedge assembly to the pads on the underside of the Disc board. Repeat for the second side. If the Disc board is double-sided (has copper on both sides), then repeat on the top side.

(7). Mount all components as per the overlay diagrams in Fig.8 and the text that follows.

Wedge lamp assembly

With the wedge lamp "skeleton" complete, it's time to mount all the components. Begin with the eight 5mm LEDs on the Disc board, aligning the cathode (flat) sides towards the centre of the board.

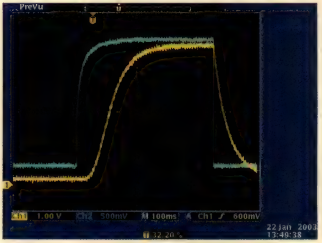
Fit the 10mm (centre) LED last. The flat (cathode) side must be aligned towards the "dot" side of the board. The "dot" side is marked with a small copper dot (pad without a hole) on the underside. Form the leads as shown in Fig.7 and push the LED down until it makes contact with the head of the

The LED bayonet lamp is made by scrounging the base from a conventional bayonet lamp and fitting it with a Multidisc module. Note that the latter sits on top of a Platform PC board (the two are secured using silicone sealant).

Response Times: LEDs Versus Conventional Filament Lamps

After upgrading the Honda's CHMSL to LEDs, we decided to "get technical" and actually measure the difference in response between the old and the new. We made up a couple of phototransistor-based sensors and positioned one behind the CHMSL and the other behind one of the stop lights. Our Tektronix scope captured the waveforms at right when we tapped the brake pedal.

As you'd expect, the blue trace represents the LED CHMSL light output whereas the yellow represents the conventional stop light. A rough estimate shows the filament lamp to be about 150ms behind the LEDs, with full brilliance at least 200ms later. The rounding on the leading edge of the LED waveform is caused by voltage drop in the wiring loom, a result of the stop lamps' cold filament current, which momentarily exceeds about 40A.



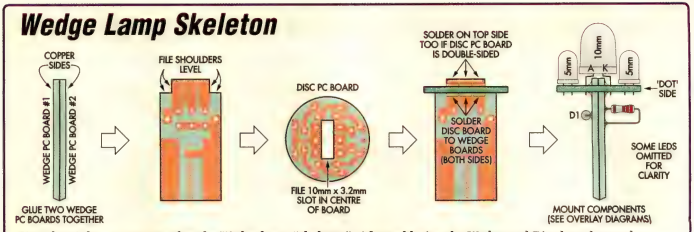


Fig.7: here's how to put together the Wedge lamp "skeleton". After soldering the Wedge and Disc boards together, inspect your work for potential solder bridges between pads. This is only important on the "dot" side, as all pads on the opposite side will be connected with a wire link anyway (see Fig.8).

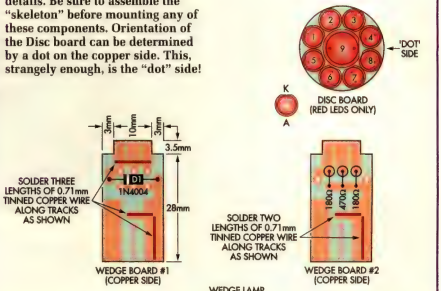
wedge board assembly.

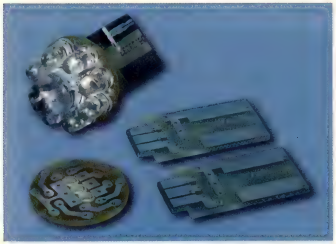
The three resistors and 1N4004 diode can go in next (see Fig.8). Note that it is vital that these components go on the right sides of the wedge assembly. As shown in Fig.7, the resistors mount on the "dot" side and the diode on the other.

Component mounting is unconventional in that the leads should not pass through both PC boards and protrude from the opposite side. The PC board holes have been deliberately offset to prevent this from happening. You'll need to bend the leads of each component and trial fit it in place, trimming back lead lengths just enough so that they enter their respective holes before soldering in place.

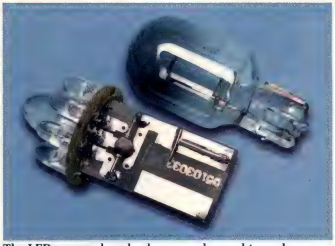
Finally, solder lengths of tinned copper along the tracks exactly as shown in Fig.8. The vertical lengths at the bottom take the place of the filament

Fig.8: the Wedge lamp assembly details. Be sure to assemble the "skeleton" before mounting any of these components. Orientation of the Disc board can be determined by a dot on the copper side. This, strangely enough, is the "dot" side!





The wedge lamp is made up using the Disc board and two identical Wedge boards. It all goes together as shown in Figs.7 & 8.



The LED-powered wedge lamp can be used to replace a conventional filament lamp in some situations and will generate much less heat.

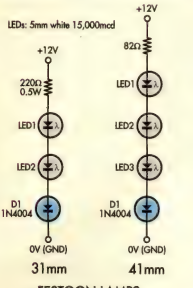


Fig.9: the circuit details for the 41mm & 31mm festoon lamps.

31mm & 41mm Festoon Lamp Assemblies

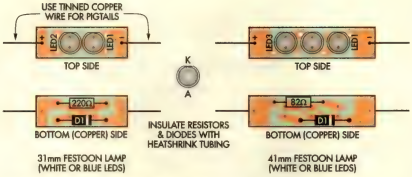
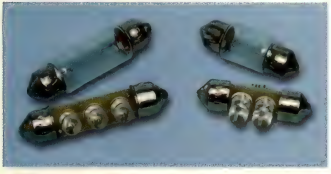


Fig.10: the assembly details for the 31mm (left) & 41mm (right) festoon lamp modules. The end caps are soldered to the PC boards after the parts have been installed.



The completed festoon lamp assemblies can be plugged straight into a conventional festoon lamp holder but must be oriented with the LEDs facing outwards.

lead-outs on the base of a wedge lamp and need to be positioned so that they mate with the contacts in the wedge socket. The horizontal lengths replace the "bump" on the wedge bulb base that is captured by a spring clip in the socket in order to retain the bulb.

Festoon lamp assembly

This LED equivalent of the festoon (interior) lamp can be built in either a 31mm (2 LED) or 41mm (3 LED) version. As mentioned previously, you have the choice of using either white or blue LEDs.

Referring to Fig.10, begin by installing the LEDs, aligning the flat (cathode) sides as shown. Be sure that you have the PC board oriented as shown on the overlay; the positive side must be on the left. The "+" and "-" symbols on the copper side allow you to determine correct polarity.

Now flip the board over and install the resistor and diode on the copper side. Both of these components should be insulated with heatshrink tubing to prevent short circuits. However, only the leads of the resistor should be insulated (not the body), otherwise heat dissipation will be impaired.

Next, solder 10mm lengths of 0.71mm tinned copper wire to each end of the board, forming axial "pigtails". These wires will make the con-

The three current-limiting resistors are mounted vertically on the wedge assembly and can be insulated with heatshrink tubing if desired.

The diode goes on the other side of the wedge assembly. The three long pads on both wedge boards are soldered to matching pads on the disc board.

Parts List

High-Mount Stop Lamp (HMSL) Module

1 PC board, code 05103033, 11.45mm x 149.2mm
16 5mm 20,000mcd red LEDs (LEDs1-16) (Vishay TLCR5800)
2 1N4004 diodes (D1, D2)
4 150Ω 0.25W 1% resistors
200mm length of red light-duty hookup wire
150mm length of black light-duty hookup wire

Multidisc Module

1 PC board, code 05103036, 26.5mm diameter
12 5mm 20,000mcd red LEDs (LED1 - LED12) (Vishay TLCR5800)
1 1N4004 diode (D1)
3 180Ω 0.25W 1% resistors
10mm length of 0.71mm tinned copper wire
20mm length of 5mm-diameter heatshrink tubing
150mm length of red light-duty hookup wire
150mm length of black light-duty hookup wire

Wedge Lamp

1 PC board, code 05103031, 22mm diameter (Disc)
2 PC boards, code 05103032, 31.5mm x 16mm (Wedge)
8 5mm 20,000mcd red LEDs (LEDs1-8) (Vishay TLCR5800)
1 10mm 6,000mcd (min.) red LED (LED9)
1 1N4004 diode (D1)
1 470Ω 0.5W 1% resistor
2 180Ω 0.25W 1% resistors
60mm length of 0.71mm tinned copper wire
Cyanoacrylate-based adhesive (super glue)

Bayonet Lamp

1 assembled Multidisc module
1 PC board, code 05103037, 26.5mm diameter (Platform)
1 14.5mm O.D. copper water pipe joiner
1 12V 21W single filament automotive bayonet lamp

31mm Festoon Lamp

1 PC board, code 05103034, 8mm x 24mm
2 5mm 15,000mcd white LEDs (LED1, LED2)
1 1N4004 diode (D1)
1 220Ω 0.5W 1% resistor
1 31mm automotive festoon lamp
20mm length of 0.71mm tinned copper wire
35mm length of 5mm diameter heatshrink tubing
5-minute epoxy

41mm Festoon Lamp

1 PC board, code 05103035, 8mm x 33mm
3 5mm 15,000mcd white LEDs (LED1 - LED3)
1 1N4004 diode (D1)
1 82Ω 0.25W 1% resistor
1 41mm automotive festoon lamp
20mm length of 0.71mm tinned copper wire
35mm length of 5mm-diameter heatshrink tubing
5-minute epoxy

nections to the end caps.

With the board assembly complete, the next step is to fit the end caps. Begin by removing the glass cylinder and filament from a standard festoon lamp. Take care to remove all glass fragments from inside the caps.

Desolder the holes in the cap peaks and then slip them over the pigtails. Push the PC board as far as it will go into each cap. The assembled size should be close to the 31mm (or 41mm) mark. Snip the wires off so that they only just protrude through the cap peaks. Now solder in place and smooth off with fine glass paper or similar.

Check that your completed lamp works in-situ and, assuming all is well, fill the end caps with 5-minute epoxy to make the job permanent.

Automotive lamps vs. LEDs

The extremely narrow emission angle of these ultra-bright LEDs (4°) makes them well suited for use in high-mount stop lights. However, in the case of conventional tail, stop and turn indicators, there are some potential visibility issues.

When viewed on-axis, a tight grouping of these LEDs certainly appears to equal (or even surpass) the intensity of a 21W filament bulb. The bulb, however, emits light over a much larger area, resulting in good visibility over more than 180°.

Naturally, the reflector and diffuser in light housings is designed to take this into account, so if we were to simply switch the standard bulb for a bunch of LEDs, the resultant light pattern would be entirely different.

Simply put, direct replacement of filament lamps with LED lamps in existing automotive tail, stop and turn assemblies will not always be possible. This applies particularly to "wraparound" styles, which must provide light to both the rear and side of the vehicle. This problem is easily solved by designing the assemblies

Where To Get The LEDs

Jaycar Electronics stock suitable 5mm red LEDs (20,000mcd), Cat. ZD-1790. Oatley Electronics have the 5mm white LEDs (15,000mcd) and a good selection of other colours as well. Our 10mm red LEDs came from Dick Smith Electronics, Cat. Z-4067.

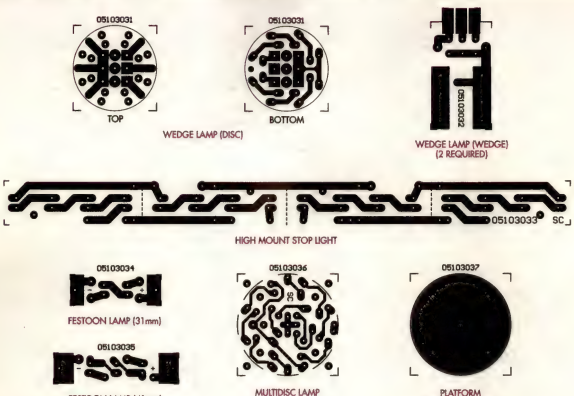


Fig.11: here are the full-size etching patters for all the PC boards. Check your boards carefully for defects before installing any parts.

specifically for LEDs, a task best left to the experts.

Having said that, we believe that our modules have a multitude of highly practical uses. Here are just a few examples:

Where to use LED lamps

Why not add a centre-mount stop light to your trailer or van? The small size and shape of the Multidisc module will allow it to fit neatly within commonly available trailer stop light assemblies. Do you own a motorcycle? What about a truck? Get noticed!

A couple of these hooked up to a simple flasher circuit and mounted under the boot lid or on a moveable panel would make the ultimate emergency beacon for late-night breakdowns. They will flash for days without running your battery flat!

In addition, the Multidisc module could be fitted with IR LEDs for use with CCD cameras and night viewers.

The LED festoon lamps don't put out as much light as the originals but they don't get hot and they won't run your battery flat in a hurry. Fit a couple under the hood, in the boot, along the floor line or in the door panels. For that high-tech look, try blue (or even true green) LEDs instead of white.

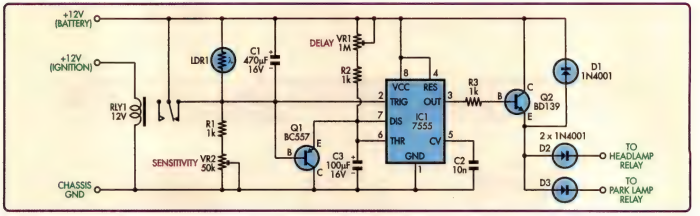
If you don't want to modify existing light housings, then the LED wedge or bayonet lamps are a good option. They're plug-in replacements for two popular auto lamp styles. If your vehicle uses different lamp styles, then you may be able to modify our designs to come up with something suitable.

Have fun! **SC**

Although not readily apparent from the photo, the modified high-mount stop lamp with the LEDs is brighter than the conventional lefthand & righthand stop lamps. Its response time is quite a bit shorter as well (ie, it turns on much faster when the brakes are applied).

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Automatic headlight switch

This circuit will switch on your car's headlights at a presettable ambient light level. It has a delayed switch-on time of about 15 seconds so that the headlights don't switch on unnecessarily when driving under trees, overpasses, etc.

The circuit is based on a 555 monostable timer circuit which is triggered by a decrease in light level. Power is applied permanently to the circuit from the 12V battery but the circuit is disabled by the relay contacts which pull pin 2 high. When the 12V relay is energised (when the ignition is turned on), the relay contacts open and the voltage at pin 2 is now set by the voltage divider comprising the light dependent resistor (LDR1), resistor R1 and trimpot VR2.

Sudden changes in this voltage are impossible due to the 470µF capacitor C1, connected across LDR1. It eliminates sensitivity to sudden changes in light level. However, once the light level drops, the resistance of LDR1 increases and so the voltage at pin 2 drops and triggers the timing circuit. At the same time, the base of Q1 is pulled low and this discharges the timing capacitor, C3.

The pin 3 output of IC1 now goes high to turn on Q2 which drives the headlamp and parking lights relays. Q2 remains on while capacitor C3 charges towards +12V via resistor R2 and the delay trimpot VR1. VR1 sets the on-time for a period of up to two minutes. However, if the light level stays low, Q1 holds C3 in the discharged state and the lights stay on.

The 2-minute delay time avoids any erratic switching of the headlights due to street lights and also allows the headlights to stay for a short time after you turn off the engine.

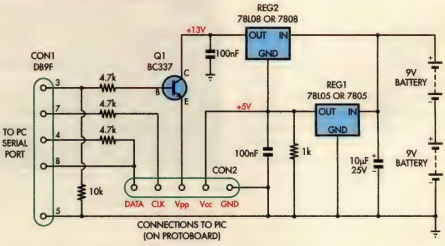
Rick Goodwin,
Moonah, Tas. ($35)

Simple universal PIC programmer

This simple programmer will accept any device that's supported by software (eg, IC-Prog 1.05 by Bonny Gijzen at **www.ic-prog.com**).

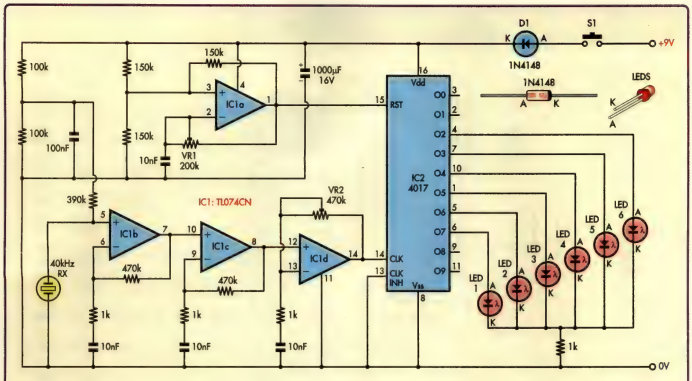
The circuit is based in part on the ISP header described in the SILICON CHIP "PIC Testbed" project but also features an external programming voltage supply for laptops and for other situations where the voltage present on the RS232 port is insufficient. This is done using 3-terminal regulators REG1 & REG2.

The PIC to be programmed can be mounted on a protoboard. This makes complex socket wiring to support multiple devices unnecessary. 16F84A, 12C509, 16C765 and other devices have all been used successfully with this device.



Luke Weston,
Wycheproof, Vic. ($30)

Note: this simple circuit will not work with older laptop computers that use low voltage (5V) RS-232 signals.



Bat detector picks up ultrasound

It is well known that bats use ultrasound for navigation and the location of prey. Typically, bats emit rapid bursts of ultrasound in the region of 15-200kHz (ie, beyond the range of human hearing), with wide variations in frequency, depending on the species.

This bat detector is a highly sensitive circuit that "hears" bats in the range of about 20-80kHz. Although this doesn't cover the full range of sounds that many bats emit, it is more than sufficient to detect the average bat at a range of tens of metres.

In operation, the circuit uses an array of LEDs to give a visual indication of a bat's presence, instead of reproducing the audio at a lower frequency. This has two advantages: (1) the absence of headphones enables you to hear sounds that would otherwise be obscured – eg, the flutter of a bat's wings or the lowest frequencies which a bat emits (sometimes audible as high-frequency, "scratchy" sounds); and (2) it effectively eliminates low frequency sounds (such as hands holding the detector), which can be the bane of budget bat detectors.

The ultrasound is picked up with a standard 40kHz ultrasonic transducer. This transducer is effective up to about 80kHz, although its sensitivity drops off either side of 40kHz. A quality piezo transducer could also be used here but note that this will only be effective up to about 50kHz (if that).

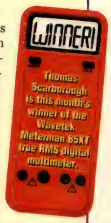
Op amps IC1b-IC1d are wired as a very high gain preamplifier, amplifying the signal millions of times. This produces sufficient signal amplitude at pin 14 of IC1d to directly clock decade counter IC2 (4017).

IC2 is reset at regular intervals by op amp IC1a which is wired as an oscillator. This resets IC2 at about one tenth the rate of the highest detected frequency. Therefore if, for an example, a 30kHz signal is received, IC2 might only sequence two or three LEDs before being reset. By contrast, if an 80kHz signal is received, IC2 will sequence all the LEDs.

This technique thus provides a visual indication of the received frequency. Note that ultrabright LEDs are recommended for LEDs 1-6, since the LEDs have only a 10% duty cycle.

In use, trimpots VR1 (frequency adjust) and VR2 (gain) are initially both set to mid-position. These may then be further adjusted later on, as required.

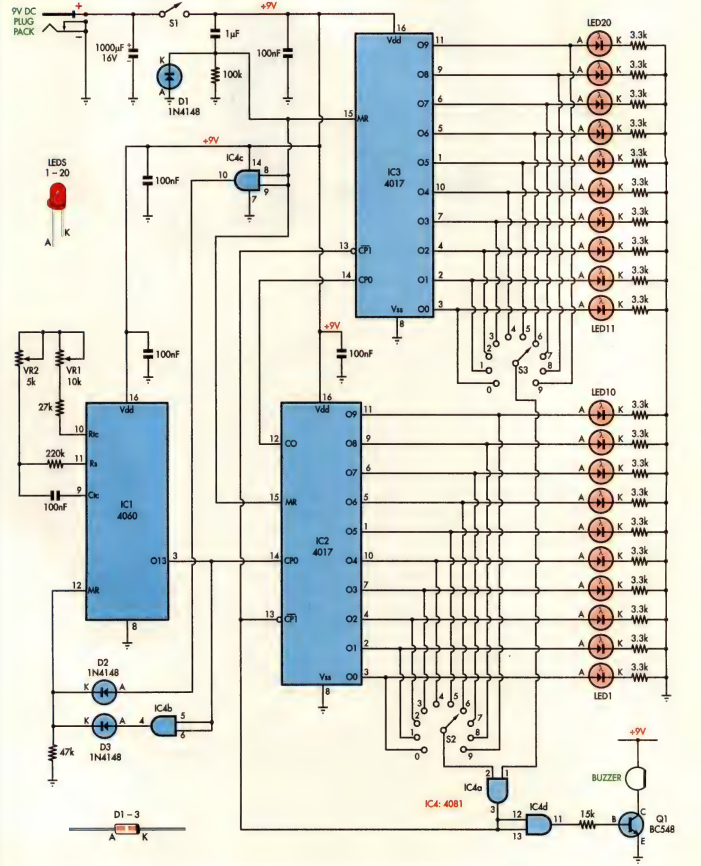
Once the circuit has been built, switch on and rub your hands together near the ultrasonic transducer. This should light at least one (and perhaps all) of the LEDs. If the circuit is functioning correctly, it should respond to your hands being rubbed together at a 1-metre distance.



If VR1 is set so that IC1a operates at 10kHz, LEDs 1-6 will represent 20-80kHz in 10kHz increments. At least, that's the theory – in practice, IC1a is adjusted using VR1 so that the LEDs match the range of the transducer that's been used.

Besides being used as a Bat Detector, the circuit could also be used as a simple tool to indicate frequency, to find tyre punctures (which emit ultrasound), and to detect other creatures which emit ultrasound (such as certain insects). And at its lowest frequency setting, it could even be used as a simple frequency-to-light convertor, with the LEDs dancing to nearby music.

Thomas Scarborough, Cape Town, South Africa.


9V DC PLUG PACK
S1
+9V
1000µF 16V
1µF
100nF
100k
D1 1N4148
LED20
LED11
LED10
LED1
LEDS 1 – 20
IC3 4017
IC2 4017
IC1 4060
IC4c
IC4b
IC4a
IC4d
IC4: 4081
VR2 5k
VR1 10k
27k
220k
47k
D2 1N4148
D3 1N4148
D1 – 3
S2
S3
BUZZER
1.5k
Q1 BC548
3.3k

Junkbox-parts oven timer

The motivation for this project came when the timer on our oven failed for the second time. It uses parts that were mostly scrounged from my junkbox.

The resulting timer is very user friendly. You simply dial in the required timing interval in minutes using rotary switches S2 (units) and S3 (tens) and then hit the start switch (S1). Any time up to 99 minutes can be selected.

When S1 is turned on, the display LEDs light, initially indicating "00" and then advancing "01", "02", . . . , "09", "10", "11", etc until the selected timing interval has been reached. The timer then stops counting and sounds a buzzer until the start switch is turned off.

The indicator LEDs can be arranged in semicircular fashion around the switches (ie, one LED at each switch position), thus giving a very effective display. This was much simpler than using a digital readout.

The circuit itself is based on four low-cost CMOS ICs. IC1, is a 4060 14-stage binary counter/divider/oscillator. It's set up to produce a positive-going pulse at its pin 3 output (O13) every minute, as set by the timing components on pins 9, 10 & 11. This means that O13 must have a period of two minutes – ie, it will be low for the first minute and then go high for the next minute. This high-going pulse is then applied back to IC1's reset pin (pin 12) via AND gate IC4b and diode D3. The counter thus restarts and begins counting the next minute interval and so on.

The period of oscillation is approximately 2.2RC where R is the resistance connected to pin 10 of IC1 (27kΩ, VR1 & VR2) and C is the capacitance on pin 9. VR1 and VR2 provide coarse and fine adjustment of the oscillator frequency, respectively.

IC2 & IC3 are two 4017 decade counters, each having 10 outputs (O0, O1, O2 and so on up to O9). Only one output of each counter will be high at any one time. The counters are reset by taking their pin 15 (MR) inputs momentarily high and this takes the O0 outputs of each counter high. These outputs in turn drive LEDs 1 & 11 and this indicates zero or "00" (the initial state of the counting process).

Each positive-going pulse on pin 14 (CP0) of IC1 advances the count by one, with LEDs 2-10 turning on in sequence to indicate the number of elapsed minutes. When nine pulses have been counted, LED10 will be on. The tenth pulse then resets IC2 (ie O0 goes high and turns on LED1). In addition, IC1's carry out pin (pin 12) goes from low to high and this clocks IC3. As a result, IC3 counts in tens on minutes while IC2 counts the units.

By using the 1-minute pulses from IC1 to clock IC2, the two counters are capable of recording the elapsed time up to 99 minutes, after which both counters are reset to zero and the count restarted.

Both counters can be halted at any time by taking their enable pins (pin 13) high. If this is done, the counter outputs will remain locked at the prevailing count at the time of receiving the disable signal.

As well as driving LEDs 1-9, IC2's outputs are also connected to S2, a single-pole 10-position rotary switch. Similarly, IC3's outputs are connected to rotary switch S3. The wipers of S2 and S3 connect to AND gate IC4a and when both inputs to this gate are high, its pin 3 output goes high and disables the counters.

At the same time, the output of IC4d (pin 11) goes high and turns on transistor Q1 to sound the buzzer. The counters then remain locked in this count position and the alarm continues to sound until the start switch, S1, is turned off.

Because the 4017 ICs can only source a small amount of current, special low-current LEDs must be used. The types used in the prototype were from RS Components, stock number 590-547. These operate with just 2mA of current, with a maximum forward current of 7mA.

Power for the circuit comes from a 9V DC plugpack. Note that the start switch is placed after the 1000μF reservoir capacitor. This prevents the buzzer from making an awful "dying noise" as the capacitor discharges when the timer is switched off.

Jack Holliday,
Nathan, Qld. ($50)

CONTRIBUTE AND WIN!

As you can see, we pay good money for each of the "Circuit Notebook" contributions published. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win one of these superb Wavetek Meterman 85XT true RMS multimeters - valued at around $380! So don't keep that brilliant circuit secret any more: send it to SILICON CHIP and you could be a winner!

1 meter to win every month!

Contributions must be your own original work or a major adaptation and not published elsewhere nor submitted for publication elsewhere. SILICON CHIP's decision is final.

ICY ESKY

Last century, we described a Peltier-powered tinnie cooler which could be built into a reasonably large Esky and so keep your food and drinks cool. Here's another one – quite a bit smaller and just right to build into a 6-pack Esky to really cool down the tinnies. As a bonus, it will also keep food warm!

By Ross Tester

Every true-blue Aussie knows there is nothing worse than a warm beer (or soft drink, for that matter). But how do you get your drinks cold – and keep them cold? There's the old ice-in-the-Esky routine. But ice melts – especially if you keep putting warm cans in.

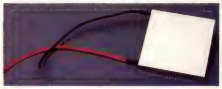
Wouldn't it be nice to have the cooler itself cool your cans? This one does! Just plug it into your car cigarette lighter (or any other 12V DC supply) and it will silently cool cans down to the "aaaaaaahhhhhh" level.

Like the cooler we presented back in September 1999 (see, it was last century!) this one is based on a Peltier Effect device. We explained this semiconductor device and its operation in some detail in that issue (and in the August 1999 issue) so we won't go into too much detail again.

Suffice to say that it consists of a number of P-N junctions sandwiched between two metal plates. Pass current through the junctions one way and they absorb heat – one of the plates gets very much colder than the other. Pass current through the other way and the reverse happens, the plate which was cold heats up.

If you thermally bond the Peltier (that's shorthand for Peltier Effect device!) to another object, that object will either cool down or heat up, depending on the polarity of supply to the Peltier. That's why a Peltier can be used for both cooling and heating.

If you'd like more info on the operation of Peltier Effect devices, we suggest you refer to the issues mentioned above.



Just in case you haven't seen one before, this is what the Peltier device looks like. This is a lower rated device than the one in this module.

Peltier "module"

There are two major differences between this project and the earlier one.

First, it's much smaller – this one is designed to fit into a 6-pack cooler (the earlier one fitted a larger cooler). It really is intended as a drink cooler, not a mobile fridge!

Second, and most importantly, this

(Above): the Peltier module attached to the top of the cooler lid while below is the view from inside the cooler.

project is based on an almost-complete Peltier module.

The earlier project required you to source the bits individually; this one has a pre-assembled Peltier module which includes a fan, heatsink, thermal switch, aluminium block and gasket.

All you have to supply is an aluminium plate (size to suit your cooler) and a small piece of, say, 15mm-wide polystyrene foam (such as used for packaging).

The aluminium sheet needs to be as large as possible to ensure good heat transfer. We used a sheet 3mm thick because it was available – even thicker would be better still.

Incidentally, the module comes from Oatley Electronics and costs the princely sum of just $33.00 (plus p&p). Not real shabby, that: we've seen similarly rated Peltier Effect devices alone advertised for the best part of $150.00

Oh, nearly forgot: you also have to supply the cooler!

Thermal shock

Before we go too much further, a warning: one thing you cannot do with a Peltier is switch it between heating and cooling (or vice versa) without waiting for it to cool (or heat) back to room temperature. This would place enormous stresses on the device and would quite likely damage or even destroy it.

We have shown a "reversing" switch in our circuit of the device but bear in mind the comments above before switching over!

Thermal bonding

The reason we placed the module in the lid of the cooler was that it was convenient to do so. It's also true that cold air falls, so theoretically the air inside the cooler would eventually cool down via convection currents.

However, as every good cook will tell you, the secret in heating or cooling food or drinks is the thermal bond between the cold/heat source and the item being cooled/heated.

Now we have to say that the thermal bond between the aluminium plate and the cans in the cooler is not that great. The reason for this is that air is not particularly efficient at transferring cold/heat.

It's a bit like trying to boil a kettle by holding it above a hotplate rather than

placing it on it. Sure, the kettle will eventually get hot – but nowhere near as fast or efficiently as it would placed directly on the hotplate.

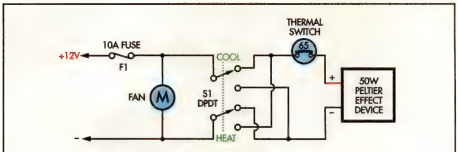
Similarly, it would be much better if the cans could be placed in intimate contact with the aluminium plate attached to the Peltier.

One way to achieve this would be to place the Peltier module not on the lid but on the side of the cooler, with an "L" shaped aluminium plate running down the side of the cooler and across the bottom, so that the cans actually sat on the cooling plate.

Even better would be to sit the cans in a small amount of water because this would achieve a much better thermal bond with the cans than the air in the cooler.

Indeed, using a cooler is not the only possibility. We've had thoughts about using a small length of suitably-sized aluminium tube, maybe a yacht mast extrusion, which often has a flat on one side suitable for mounting the block (or maybe even the Peltier direct). We haven't tried this yet – but will do so when we find a suitable extrusion.

We'll leave you with those thoughts in case you want to experiment. Placing the module in the lid of a cooler, as we have done, is certainly not the only possible approach.



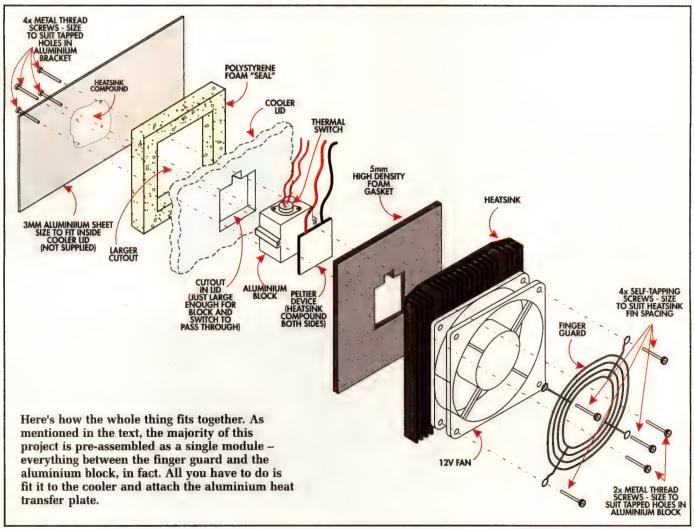
SC PELTIER-EFFECT TINNIE COOLER

This very simple circuit could be made even simpler if you don't want the "heat" option: leave out the switch and thermal switch.

Assembly

Because the Peltier module is pre-assembled, building this project is pretty simple: you cut an appropriate hole in the cooler (slightly larger than the aluminium block), pass the cooler module through it, fit the styrene foam seal and screw on your aluminium plate. Connect power and it's done.

The power lead would ideally be a suitable length (but shorter rather than longer) of polarised (red/black?) 10A figure-8 cable, fitted with a car cigar



Here's how the whole thing fits together. As mentioned in the text, the majority of this project is pre-assembled as a single module – everything between the finger guard and the aluminium block, in fact. All you have to do is fit it to the cooler and attach the aluminium heat transfer plate.

lighter plug at one end. Note that there are some "cheap" cigar lighter plugs around that are real junk – their springs aren't and deform badly after a few uses. It's better to pay a little bit more and get a good'n.

For safety's sake we have incorporated a 10A fuse in the + line between the changeover switch and the cigar lighter plug. 10A is more than is needed by the Peltier and fan but should protect in case of catastrophic short circuit.

Speaking of catastrophic, we have shown an "exploded" drawing of the assembly but that's just in case you need to know how it all goes together. However, you should not need to disassemble the Peltier module.

One thing you will note on the drawing is the use of heatsink compound, especially between the aluminium block and the aluminium plate. This will ensure maximum heat transfer.

The thickness of the styrene block depends on the thickness of the lid (or wall) of your cooler. The idea is that it compresses slightly when the aluminium plate is screwed to the block, making a nice airtight seal against the cooler lid/wall but still allowing the block to make intimate contact with the aluminium plate.

The high density foam gasket (supplied with the module) forms the airtight seal on the outside of the cooler.

The two seals probably won't be watertight but with a bit of work with silicone sealant could possibly be made so. Just make sure you don't get any sealant between the heatsink and Peltier, the Peltier and block or the block and plate – it is a good way to stop heat transfer!

The thermal switch

The project has a 65° thermal switch mounted on the side of the aluminium block.

This only comes into play when used as a heating device and is designed to prevent the thing getting so hot it starts melting (or at least deforming) the plastic lid or body of the cooler.

If you are not intending to use the device as a food heater, it (and of course the reversing switch) can be left out.

Power supply

The 50W Peltier device draws around 3.5A at 12V (DC). Therefore it is going to place a fairly significant load on your car battery if the engine is not running – certainly enough to prevent you starting the car after a day out.

Still, if you *are* caught out in the sticks with a battery that's too flat to start your car, your drinks will be beautifully cold. . .

Of course, you could also run it from a suitable 12V (or 13.8V) DC power supply – a typical "CB" power supply is rated at about 4-5A so would be perfect.

Upside-down view of the module as supplied by Oatley. Note the liberal use of heatsink compound on the aluminium block – you cannot see it in this photo but there is also a good dollop of the stuff on both sides of the Peltier device.

Parts List – Tinnie Cooler

1 Peltier Effect module (Oatley Electronics)
1 6-pack plastic cooler
1 3mm thick aluminium plate, size to suit cooler
Suitable fig-8 connecting cable with car cigar lighter plug
In-line fuseholder and 10A fuse (can be integrated with cigar lighter plug)
Heatsink compound
1 DPDT switch, 5A DC contacts (optional, see text)

Where from, how much?

The Peltier Device Module, complete with heatsink, fan, aluminium block, thermal switch and gasket, is available from Oatley Electronics for $33.00. The various components may be purchased separately elsewhere but be prepared to pay at least $100!

You need to supply the cooler (and the drinks to go in it!), aluminium plate, polystyrene foam, power lead, inline fuseholder and fuse, cigar lighter plug, heatsink compound and (if required) the DPDT changeover switch.

As a special bonus, Oatley Electronics will also include a quality car cigar lighter plug, with integral fuseholder already connected to a 1.8m length of heavy duty figure-8 cable, if you tell them you are building the SILICON CHIP Cooler project.

Contact Oatley Electronics via phone (02) 9584 3563; fax (02) 9584 3561; email – sales@oatleyelectronics.com or via www.oatleyelectronics.com.

SERVICEMAN'S LOG

Bring your hammer-drill & muscles

A serviceman does not just fix faults, advise customers on new equipment, or fit a new antenna. Many new, large sets often require a lot of muscle and constructional skills outside electronics. And I had another job this month which should have been avoided.

I can't help myself. Yes, I did it again; lumbered myself with a repair that I should have stayed well clear of. But I did have some mitigating circumstances.

It's my wheels. Because I'm so badly paid, I have to use secondhand vehicles and my old Ford Laser was just about to dump its gearbox. Ouch!

Anyway, I was sulking over this latest problem one morning when in waltzes an old colleague. And in the ensuing conversation, he mentions that he is trying to fix a Philips FL1.1 with an east-west pincushion fault. I told him to wash his mouth out for mentioning such words in my presence. But grateful that it was someone else who was suffering from such misfortune, I offered as much free advice as I could – as long as he was doing the work.

BELIEVE ME, IT WAS LOUD ENOUGH TO HAVE AWOKEN THE NEW ZEALANDERS...

That is, until it turned out that his client was a Ford transmission expert and repairs them all day long. Suddenly I realised that a dangerous contra deal was in the air but I quickly lost all sense of reasoning. I mean, how bad can a TV fault be? And after all, I could end up saving many hundreds of dollars.

In due course, my car went east and his TV set came west; straight into my workshop. And being a 33-inch (80cm) set, I almost had to rebuild the workshop around it to get it to fit.

The set turned out to be a model 33FL1880/75R, the same as one I wrote about in last month's issue. This set had the same problems as the one in that article and my friend patiently worked through it until, finally, he too discovered that capacitor C2523 (8.2nF, 2kV) capacitor was the cause.

He then replaced all the blown up bits and that fixed everything except the east/west fault which had him stumped. I had hoped for a minute that it was just transistor Q7610 (2SA1359) that was faulty, as in the earlier set, but he had already changed that.

Anyway, I own two working FL1 TV sets and another which also has an east-west pincushion fault, though none of them are 33-inch models. I checked all my friend's work first and apart from replacing the horizontal output transistor ON4673 with a BU508A (a BU508AF is an even better choice), nothing apart from a few faulty joints was obvious. However, the voltage on the emitter of Q7610 was only 1.8V instead of 14V and neither the width adjustment (VR-3601) nor the pincushion control (VR3602) had any effect.

I had heard that shorted turns in coil L5526 could cause this fault, so I swapped this coil with the one in the good set. Unfortunately, it made no difference to either model and both coils had an inductance of 11mH.

I then decided to try similarly swap-

ping transformers 5521. This turned out to be a monstrous mistake, as it instantly took out both horizontal output transistors. After replacing these, I still couldn't get the set to start and there was no 141V rail. Eventually, after a lot of messing about, I discovered that Q7610 was short circuit but the set was still dead when this was replaced.

Next, I unsoldered pin 8 (141V input) to the horizontal output transformer and horizontal output stages and fitted a 100W globe across the rail instead. This time when I switched it on, there was an enormous bang, like a shotgun going off. Believe me, it was loud enough to have awoken the New Zealanders.

Well, at least I had produced a measurable reaction – a small earthquake! The only trouble was I didn't have a Richter meter to measure it!

In fact, it was C2512 in the horizontal centring circuit which had exploded. It took quite a while to realise that Q7512, Q7513, R3514, R3537, R3515 and D6515 had also been destroyed. When I finally put it all back to where I started, I made an emphatic mental note: not all FL1.1S chassis are the same and not everything is interchangeable.

However, the east-west circuits are similar and therefore the voltages and waveforms between the sets should also be similar. As a result, I spent an hour or so measuring the good 29-inch set's east-west correction circuit voltages and drawing the oscillograms.

As I have mentioned on previous occasions, access to this chassis is rather difficult. The so-called service position is with the main chassis (small and large signal panel) pulled right back and up. You then have to balance it on its edge, taking care not to short out the CRT socket with the heatsinks. The control panel and mains filter panel remain behind.

The chassis is bulky and heavy, with modules and heatsinks everywhere – mostly soldered in. The voltages in some parts are very high, with sensitive surface mounted components nearby. Replacing a part requires access to both sides of the board, which means moving them up and down.

Finally, just to make life interesting, the 315V main HT line remains charged even after the set is switched off – not to mention the 200V rail for the RGB output amplifiers. And because the whole chassis is precariously balanced in the "service" position, it's impossible to safely attach a probe onto a subminiature component and take a reading.

It's also impossible to make any service adjustments while in this service position, as the controls are all on the inaccessible side of the board. In fact, even in the so-called "accessible" position, they aren't easy to get at! For example, to measure and adjust the 141V rail, it's necessary to attach the probe onto test point TP57 (cathodes of D6237 and D6238). What they don't tell you is that these sit right between a heatsink and the SOPS module and there is very little clearance between these two parts.

In practice, it is necessary to go to standby, connect an insulated crocodile clip onto the diode, then switch on using the remote control and adjust R3371. And you really have to watch yourself: one third of the large signal panel is at full mains potential and the other two thirds is at chassis – and the dividing line is not easy to see. No wonder no-one likes fixing these beasts.

Basically, the east-west circuitry converts vertical pulses derived from the vertical deflection output into upside-down parabolas. These are then fed to the east-west output transistors which in turn drive one end of the deflection yoke via a variety of tuning components. The other end of the deflection yoke is fed with 1000V horizontal pulses. EHT information is also applied to prevent picture blooming on bright screens.

The preamplifier stages consist of four surface-mounted transistors which are controlled by the width and pin controls. Unfortunately, the circuit diagram is full of errors, with few voltages and waveforms.

I replaced all the surface-mount transistors and all the electrolytics but the fault persisted. Despite that, the two sets compared quite well, although factors such as the control positions, the size of the sets and the beam current due to picture content made it difficult to work out what was important and what wasn't.

The main factor was the voltage on the emitter of the east-west output transistor (Q7610) which was constantly far too low. The breakthrough came when I noticed that one of the

Items Covered This Month

- Philips Matchline 33FL1880/75R TV set.
- Panasonic "Progressive Wide Plasma Displays" (Model TH-42PWS) – installation.
- Akai TX-140 stereo unit.
- JVC AV-21 TEAU TV set (MZ2 chassis).
- Faulty remote controls

east-west modulator diodes, D6526 across the horizontal output transistor, went to C2504 and not to the emitter. I also noticed a thick black jumper lead across the two emitters of Q7504 and Q7506. However, this lead was unnecessary because they already had a link on the other side.

Granted, it's not uncommon in TV sets to have what may be considered redundant links. Sometimes it's because there is high current and sometimes it is to limit inductance. However, the link was not fitted in the 29-inch model, so what was it's purpose?

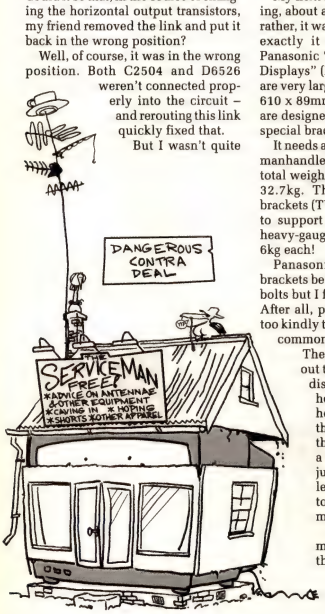
There seemed to be no reason – unless the link was in the wrong place. Could it be that, in the course of changing the horizontal output transistors, my friend removed the link and put it back in the wrong position?

Well, of course, it was in the wrong position. Both C2504 and D6526 weren't connected properly into the circuit – and rerouting this link quickly fixed that.

But I wasn't quite out of the woods yet. The east-west controls now had an effect but not enough. The voltage on the emitter of transistor Q7610, which was previously too low, was now too high – at times nearly 60V!

More careful examination revealed that R3611 (2.7kΩ) and R3614 (1.5kΩ) were both high. Replacing them brought both controls within a tolerable range.

Finally, I replaced the back and left the set on soak test. I hope that its owner has done as good a job on my transmission!



Plasma sets

My next story is not, strictly speaking, about a conventional service job; rather, it was an installation job. More exactly it involved installing two Panasonic "Progressive Wide Plasma Displays" (Model TH-42PWS). These are very large units, measuring 1020 x 610 x 89mm (plus the speakers), and are designed for wall mounting using special brackets.

It needs at least two people to safely manhandle these monsters, since the total weight (display and speakers) is 32.7kg. The special wall-hanging brackets (TY-WK42PV1) that are used to support the display are made of heavy-gauge steel and weigh a further 6kg each!

Panasonic recommends that the brackets be mounted using at least six bolts but I fitted 12 just to make sure. After all, plasma displays don't take too kindly to a fall, this being the most common reason for failures.

The first thing to do was work out the optimum height for the display (in most cases, eye height) and then drill one hole at top centre to hang the bracket. The bracket is then initially attached using a single M6 bolt, then adjusted with the aid of a spirit level and used as a template to drill the holes for the remaining bolts.

It was also necessary to mark a cable access hole on the bottom lefthand side. This hole (30 x 100mm) needs to be drilled right through to the brick cavity in order to accommodate the cables. Another hole then has to be drilled where the cables are to emerge and connect to the associated AV equipment – VCR, DVD player, digital set-to box, amplifier, etc.

I was annoyed that most of the accessories were not immediately available from Panasonic and I hope they will fix this soon. For example, I wasn't able to get the TV-PT600E (and TY-42TM5H, TY-SCP15C03, TY-42TM5T) tuner/receiver. Instead, I had to use an existing NV-FJ630A hifi VCR as the main tuner.

One of the display units had to be fitted across a corner, which I thought was a waste. However, that's what the customer wanted and he was paying.

To do this, we made up a solid metal panel which was bent over at 45° at each end and mounted vertically in the corner. We used 2mm-thick aluminium for this and I was initially worried about its rigidity but when the set was mounted, it was very solid.

I also fitted brackets to hold and conceal the VCR, which I modified so that the infrared remote control receiver was external and just peeping over the top of the display. Interestingly, I found it to be more sensitive facing the wall than looking back out towards the viewer.

When it was all finally connected, the digital reception was exceptionally good. Overall, the effect was fantastic. I just wish I could afford one!

Akai TX-140 stereo unit

A young woman brought in her Akai TX-140 stereo unit with the complaint that it wouldn't play CDs. As sometimes happens with these types of systems, I was expecting that either the laser and/or the disc motor had failed. In the former case, the disc starts to spin and the laser comes on and tries to focus. If it fails to read, the CD stops.

I removed the top cover to watch what happened and found that the three CDs on the carousel would not stop rotating around the platter. What's more, they would not line up with the CD reader.

I prised off the platter and saw how the deck worked. Each disc had a series of plastic tongues on the underside of the platter, one for disc one, two for disc two, etc. These gave a digital pulse as they passed between

an optocoupler. What was fairly obvious was that the optocoupler wasn't working.

The optocoupler is mounted on a small board with a 5-strand flexi-lead between it and the platter motor. The flexi-cable seemed to be the obvious culprit and I checked the continuity with an ohmmeter. As I suspected, two of the conductors were open circuit.

I tried repairing it by running a parallel wire with flexi-cable but it wasn't possible to solder it on, so I ordered a longer generic flexi-cable.

When this arrived, I cut it to size and stripped back the insulation about 2mm to solder onto the sub-board. Because of its size and the heat of the iron, it was quite difficult not to make a complete mess of it but with a bit of perseverance, I finally managed to solder it on. The reassembly was a breeze and the job was done.

JVC TV set

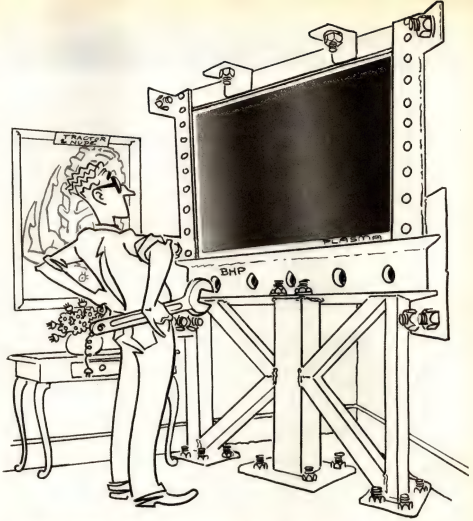
When a rather ordinary-looking 51cm JVC AV-21 TEAU (MZ2 chassis) was brought in, I wasn't really expecting anything other than a mundane repair. The set was dead and it didn't take a mental giant to figure out that the horizontal output transistor (Q522, 2SD1878-YD) was short circuit.

The only replacement I had was a 2SD1878, which wasn't fully isolated like the original but this was easily fixed with a mica washer. However, when I switched the set on there was a split second during which the normal static field around the picture tube was very much higher than normal. As I say, it was only very brief, then it was back to square one.

But while it lasted, the effect was so great that I received a shock and there was also a flash-over inside the picture tube. Initially, this made me think that perhaps the picture tube was down to air. It took another transistor failure to prove it wasn't the tube, as I had totally disconnected it by then.

The most common problems that can cause horizontal output transistors to cark it are: (1) a faulty horizontal output transformer; (2) a faulty deflection yoke; (3) excessive HT; and (4) crook tuning capacitors – although not necessarily in that order.

I unsoldered and measured tuning capacitor C524 as well as C525, but both were spot on. I then removed the deflection yoke and examined it carefully but it too appeared to be OK. I also reworked the solder on the motherboard but no joy.



WE MADE UP A SOLID METAL PANEL ... I WAS INITIALLY WORRIED ABOUT ITS RIGIDITY

Unfortunately, my copy of the service manual didn't have the circuit diagram or service adjustments for this set, which was extremely frustrating. I did have the circuits for an AV-G21AU, which is a CA2, and an AV-G25AU, which also uses an MZ2 chassis, but neither was quite close enough.

I assumed that the HT (B1) rail, at test point TP-91, should be at 114V. To confirm this, I had to replace the horizontal output transistor, short out its base and emitter and connect a 100W globe. It was spot on at 114V.

So all that seemed to be left was the horizontal output transformer. My shorted turns tester could not detect any shorts across pins 9 and 10 but that doesn't mean very much; high voltage failure in the secondary can't be detected at low voltage.

Finally, I ordered a new horizontal output transformer, confident that that was it. However, after fitting it, the set behaved exactly as before and then died.

I can't lie that I was the great brain that discovered the cause of this one – instead, it was Technical Support at Hagemeyer.

Though I thought I had been completely thorough in resoldering everything on the motherboard, I had in fact neglected to check and resolder the connection to the horizontal oscillator ceramic resonator/crystal (CF-561) on pins 14 and 17 of the jungle IC (IC201). And that was what wrong with the set in the first place, causing it go wildly off frequency and the EHT to rise spectacularly.

After realigning the yoke and CRT p/c magnetic rings, everything was fine except for one slightly bizarre problem. I didn't have the remote control but I noticed that by pushing the channel (CH) up and down buttons on the set itself, I could select "AV" input. The problem was that the video

from my signal generator wasn't going in via the AV sockets at the rear.

Conversely, I could tune it in when I plugged the generator into the antenna socket while still in the AV mode.

Initially, I thought that the AV switching ICs had failed, along with a transistor controlled by the microprocessor. Later, when I read the instruction book on this model, I learnt that it is necessary to select either "TV" or "Video" with the remote control to change the source. The "AV" mode in this set really just denotes the change in sync time constant that is required to prevent "flag waving".

Now, on a lighter note, here is a contribution from K. A. of Kingston, Tasmania. This is how he tells it.

Unreliable remotes?

A friend had been grizzling on and off over several months that all the remote controls for her new and expensive TV, DVD, and VCR were unreliable. The problem wasn't so much presented as "It's busted, will you fix it?" but during dinners as part of idle chit-chat about growing old and coping increasingly less well with new fangled gadgets.

It took ages for the various bits of information to completely emerge. Apparently, the batteries in the remotes had been replaced umpteen times, the gadgets had been taken back to the shop umpteen times (they were still under warranty) and experts had visited umpteen times. Furthermore, red herrings like too much sunlight, too much light in general, interference from modern high efficiency lights, etc had all been eliminated.

There was some hazy information that the various remotes weren't all equally unreliable. However, the details were confused and this information was no help at all.

One day, a really weird piece of information emerged; the remotes all worked well for my friend but not for her teenage son. Now if this had been the other way round, it wouldn't have been significant; teenagers often successfully use gadgets that have adults baffled.

Lacking any solid clues, I continued to offer sympathy rather than useful advice and left the problem as one of life's little puzzles. And then one day, I was visiting their home while the teenage son was watching TV and wrestling with one of those (expletive deleted) remote controls.

Aha! Problem solved!

Have you seen the way teenagers sit in chairs to watch TV?

His feet were on a footstool, his backside was dangling over the edge of the cushion, his back was where his backside should have been and his head was propped up against the back rest. Bone surgeons will make a fortune 30 years from now reconstructing his neck!

But that's not all. The remote control was on his tummy and his great big size-15 feet were between it and the IR sensors on the TV, VCR and DVD!

IR light doesn't shine through feet! – no wonder it wouldn't work.

The equipment itself was installed in a typical cabinet with the VCR on the bottom, then the DVD and the TV on top. The TV could occasionally get a glimpse of the remote control over the teenage son's toes and so it worked sometimes. By contrast, the VCR was in a deep, dark, gloomy shadow and almost never worked! **SC**

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March Madness SALE

4 Way Powerboard with Filter/ Surge and Overload Protection

This powerboard offers 4 outlets, all filtered and Surge Protected. Guard your expensive Hi Fi, TV, or VCR etc. against damage.
Features:
•4 Surge and Spike protected mains outlets •10 Amp resettable overload circuit breaker •Power on indicator in switch •Cable length: 1 metre

NEW PRODUCT

Cat. MS-4050 $19.95

4 Way Powerboard with Filter/ Surge and Overload Protection for Power and Telephone

As well as a 4 way powerboard this surge protector offers phone line protection, allowing you to protect your modems, faxes, answering machines etc. as well as your mains powered devices.
Features:
•4 Surge and Spike protected mains outlets
•Telephone / Data line Surge and Spike protection RJ 12 sockets
•10 Amp resettable overload circuit breaker
•Power on indicator in switch •Cable length: 1 metre

NEW PRODUCT

MORE NEW POWERBOARDS PAGE 3

Cat. MS-4052 $26.95

Big Display Clocks with Radio and Alarm

The most striking feature of these fantastic BIG digit clocks are the unique colour and sheer size of the LED displays. The display digits are 50mm high and can be easily read from anywhere in the room. Features include an AM/FM radio with snooze & sleep functions and a dimming switch allows you to dim the display at night time. •Optional battery backup (use SB-2423 9V battery)
Two colours available:

NEW PRODUCT

Soft Orange:
Cat. AR-1793 $39.95

Cool Blue:
Cat. AR-1794 $79.95

Pre-Programmed Smart TV / Video Remote Control

NEW PRODUCT

This pre-programmed remote is designed to operate the major functions of a TV and VCR in a single compact unit. Easy to use and is ideal for the kids to use. Preprogrammed for over 600 models.

Cat. AR-1702 $21.95

Universal 8 in 1 Pre-Programmed Remote Control with Teletext

This Universal Remote can control up to 8 devices and has features for operating most up to date equipment including teletext. It is pre-programmed to suit thousands of different pieces of equipment.

NEW PRODUCT

Cat. AR-1717 $34.95

NEW Range of Ultra Bright 12VDC Fluorescent Lamps

11 Watt 12VDC PL Cabin Lamp

This fluorescent lamp uses a single 11 Watt PL tube and has a 3 Watt night light as a courtesy lamp.Designed to be surface mounted.
Spare tube to suit - cat. ST-3007 $14.95

NEW PRODUCT

Cat. ST-3006 $39.95

12V DC 16 Watt 2D PL Round Ceiling Light

This unit uses a compact fluoro tube rated at 16 Watts, roughly equal to a standard 80 Watt globe. It would be ideal to mount over a table, as it has wide light dispersion.

NEW PRODUCT

Cat. ST-3009 $49.95

12V DC 16 Watt 2D PL Square Light

Similar in design to ST-3009 above, though it features a square body.
Spare tube to suit ST-3009 & ST-3012 - ST-3013 $19.50

NEW PRODUCT

Cat. ST-3012 $47.95

8" 4 Ohm VIFA Woofer Bargain

As used in the highly regarded MACKIE® HR 824 active studio monitors. Can be used as bass/mid driver for high quality domestic speakers or as a compact car sub.
Specifications:
•Nominal impedance: 4 Ohms
•Power Handling: 100 Watts RMS
•Frequency Response: 35-4000Hz

NEW PRODUCT

Cat. CS-2235 $99.00

Small Aluminium Case with Foam Insert (Camera / Video Case)

Features a shapeable foam insert. Ideal for carrying your camera or video equipment, or more appropriate to the size, you may like to carry delicate tools or measuring equipment. The case is lockable with two keys supplied.
•Shoulder strap included.
•407(L) x 277(W) x 98(D)mm.

NEW PRODUCT

Cat. HB-6355 $39.95

4 in 1 Rock-Climbing and Hiking Altimeter

Capable of measuring from sea level to 5000 metres, it doubles as a barometer. The mechanism is the rugged aneroid type with 50mm adjustment bezel.
The removable lanyard features a small thermometer, so has a real mountaineering feel about it. Also included is a small compass, but we see this more as a bonus than a serious instrument. A caribina like belt clip enables you to attach it to your clothing when not being used.
Measuring range: 0 - 5000m, 580 - 1040hPa
Resolution: Air pressure: 5hPa
Altitude: 20M

NEW PRODUCT

Cat. QM-7280 $49.95

In Car Mobile Phone Charger

For use with most Nokia, Motorolla and Siemens mobiles. Plugs into your cigarette lighter socket.
Features:
•LED to indicate power on, and a curly cord.

NEW PRODUCT

Cat. MB-3546 $19.95

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Hot New Books

Direct Charging Plant

Learn efficient charging techniques for deep cycle batteries. Covers charging, horsepower v. alternator calculations and much more.

Cat. BE-1530 $24.95

Simple Biodiesel

Make your own diesel fuel from used cooking oil. Covers the basics, to testing and using your fuel.

Cat. BE-1531 $24.95

Solar Electricity

Learn efficient set up and maintenance techniques of Solar systems. Covers regulation, inverters, wiring and much more.

Cat. BE-1532 $34.95

Singing Birds Door Announcer

This delightful product consists of two birds (about finch-size) perched on a plastic but realistic looking piece of branch. The branch conceals a Light Depend Resistor (LDR). When a person walks past the birds burst into song. Not only do they twitter away to each other, their beaks move as well as their tails. Requires 3 x AAA cells not included.

Cat. LA-5014 $19.95 NEW PRODUCT

Spymaster Audio Listener

NEW PRODUCT

Using this tiny unit you can hear sounds from further away than your normal hearing ability. Hearing range is up to 16m. There is a volume control on the unit so you can adjust the headphone volume and a belt clip so you can wear it however you like. Batteries included

Cat. AA-2027 $19.95

6.5" Cable Cutter

This set of cutters will cut up to 10mm cable. They are constructed from stainless steel and have a hardened long-life cutting edge. For safety and ease of storage they can be locked in the closed position.

- Stainless Steel.
- Lightweight.
- Lockable.

NEW PRODUCT

Cat. TH-1898 $16.95

Basketball Action Clock

This digital alarm clock looks like a mini basketball. When the alarm sounds you can throw it to stop the wake up call. But don't be too rough, you can't play ball with it. It's a fun clock that's fun to wake up to. Ball is 100mm in diameter. Battery included.

NEW PRODUCT

Cat. XC-0159 $14.95

New Range of Kwik Kit Modules

4 Metre IR Light Barrier Module

NEW PRODUCT

With a range up to 4 metres, this pre-assembled infrared light barrier can be mounted across a doorway or small entrance and trigger devices such as buzzers, alarms, lights or counters when somebody breaks the beam. SPST relay output. Not intended for outdoor use. See in store for details.

Cat. AA-0342 $49.95

30 Metre IR Light Barrier Module

Similar to AA-0342 to the left, though it features an effective range of up to 30metres. Ideal for extremely wide entrances, gateways etc. Features a SPST relay output capable of 24V @ 3A. Not intended for outdoor use.

NEW PRODUCT

Cat. AA-0344 $69.95

Mains Motor and Lamp Controller

NEW PRODUCT

This module can be used for various mains related applications including lamp dimming, soldering iron temperature adjustment and collector or split-pole motor speed control. Features a 600W continuous and 1200W peak loading capacity with adjustable potentiometer control.

Cat. AA-0346 $34.95

12V 5A Battery Charging Regulator for Solar Panels

NEW PRODUCT

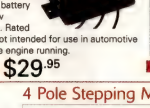
Designed for efficiently charging 12V batteries using solar cells rated up to 5-amps. It is easy to wire-up, prevents battery discharge during low sunlight and indicates charging and full battery. 5-amp fuse and fuse holder recommended - not supplied.

Cat. AA-0348 $29.95

12V Battery Guard

NEW PRODUCT

Don't be left stranded with a flat battery. This module mounts easily between your battery and load - then disconnects the load once the battery voltage falls below approx. 12.2 volts. Rated up to 8A. Note: Not intended for use in automotive situations with the engine running.



Cat. AA-0350 $29.95

Stepper Motor Interface Module for PCs

Control the speed and direction of a 4-pole stepper motor, rated between 5 to 18VDC @ 2 amps max, via your computer. Requires a split rail DC power supply rated at motor specifications. Use motors YM-2753 and YM-2752 shown below.

NEW PRODUCT

Cat. AA-0352 $49.95

Use with our motors below

Swivel Bases for TV's / Pot Plants

Making life easier, these swivel bases are strong and practical. For use where you want to adjust the viewing angle of a TV, the direction of your Hi Fi speakers or facing your pot plants into the light. Will rotate 360 degrees and can hold up to 100kg.

Available in two sizes:

12"

Cat. XC-4644 $14.95

16"

Cat. XC-4646 $19.95

NEW PRODUCT

4 Pole Stepping Motors

NEW PRODUCT

Can be controlled using our AA-0352 Computer Interface Module.

48 Step 5V Stepper Motor

- Current: 1A
- Coil resistance: 5 ohms
- Dimensions: 66mm dia x 37mm (without axis)
- Axis Dimensions: 5mm dia x 11mm
- Terminates to 4 Pin 0.1-inch header
- Weight: 385 grams

Cat. YM-2753 $19.95

40 Step 7.5V Mini Stepper Motor

NEW PRODUCT

- Current: 250mA
- Coil resistance: 30 ohms
- Dimensions: 35mm dia x 22mm (without axis)
- Axis Dimentions: 1mm dia x 10mm
- Terminates to 4 Pin 0.1-inch header
- Weight: 90 grams

Cat. YM-2752 $12.95

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New Computer Accessories

USB Digital Camera With Audio

NEW PRODUCT

Add this high-resolution USB video camera to your computer and you will be able to set up a home video link and send images to your family and friends. The camera uses a 300K pixel colour CMOS sensor, auto exposure and white balance for optimum performance and an internal microphone. The software included lets you also create virtual photo albums and photo greeting cards.

Cat. QC-3222 $79.95

Mini 4 Port Active USB Hub

NEW PRODUCT

This USB Hub is much like the others in our range except it combines two of the best features, it's small and self powered. Being self powered it allows all devices to run at full speed without compromise.

- Powered by mains plugpack included.
- Includes USB A-B Lead for connection to PC.

Cat. XC-4822 $49.95

PC Fan Cooldown Timer

NEW PRODUCT

Keep powering your CPU Fan, Graphics Cooler or other fans after you turn off your machine and stop damage that may occur if left hot after shutdown. You can set it to run for a selection of durations (up to 10 mins) and control up to two fans at once. It can be mounted permanently with screws or with the adhesive velcro supplied.

Cat. XC-5058 $39.95

GSM SIM Card Reader/Writer

NEW PRODUCT

You can view and store all records, SMS messages and change PIN codes. Read, edit, backup and add to your phonebook entries. Also allows you to Compose SMS messages on your PC, then save them to the SIM and send them later. Drivers and software are supplied for Win98, 2000, ME and XP. •Serial D9 connection.

Cat. XC-5101 $29.95

Mobile Phone SIM Card Data Bank

NEW PRODUCT

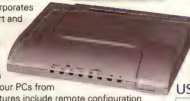
The SIM data bank provides an easy way to download the information in you mobile phone's SIM card. Features include: phonebook, reminder, calculator, memo, address book, sms book and unit conversion.

- RS232 connection to PC, complete with cable.
- Includes windows software for Win 95/98/2000 on 90mm CD.
- Uses 1 x CR2032 button cell, included.

Cat. XC-5103 $49.95

4 Port Broadband Router

NEW PRODUCT

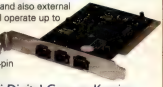


This broadband router incorporates both LAN and WAN support and is an ideal solution for connecting small networks to the internet via high speed ADSL or cable modems. The router has a built-in firewall to protect your PCs from outside hackers. Other features include remote configuration and management, VPN tunnelling, incoming port forwarding and much more.

Cat. YN-8090 $199.95

3 Port IEEE1394 Firewire PCI Card

NEW PRODUCT

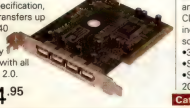


The common choice for audio and video transfer, and also external storage devices. This 3 Port PCI Firewire Card will operate up to 400mbps, and is plug n play compatible. Download digital video from your camcorder and make your own home movies with the Ulead Video Editing Software included. A 1.8m 6pin to 4pin Firewire cable is also supplied.

Cat. XC-4818 $69.95

4 Port USB 2.0 PCI Card

NEW PRODUCT



With the latest USB 2.0 specification, this 4 Port USB PCI Card transfers up to 480Mbps! That's up to 40 times faster than original USB. Featuring Plug 'n Play operation, it is compatible with all USB devices up to Version 2.0.

Cat. XC-4817 $54.95

USB Notebook Camera

NEW PRODUCT

This camera features a flexible mounting clip with adjustable ball joint for improved camera position, short USB lead with ferrite suppression, snapshot button and adjustable focus. A CD-ROM is supplied including drivers and 10 software applications.

- 352 x 288 pixels resolution
- Size: 45(L) x 29(W) x 16(H)mm
- Software suitable for Win 98, 2000, Me and XP

Cat. QC-3225 $59.95

Mini Digital Camera Keyring

NEW PRODUCT

This Digital Camera measures only 60 x 49mm and has a key ring so that you can have it with you at all times. Maximum resolution of 100K (352 x 288 pixels) allowing internal storage of up to 80 photos (20 in high resolution). Great for the outdoors, travelling and people on the go!

- Includes cable and PC software
- Uses 1x 'AAA' battery, included

Cat. QC-3190 $69.95

4 & 6 Way Powerboards with Filter / Surge and Overload Protection for Power and TV Antenna

NEW PRODUCT

As well as a powerboard, these mains filter/surge protectors offer protection for your antenna connection, allowing you to protect your TV and VCR etc. as well as your mains powered devices. Ideal for a small home theatre system or any Entertainment System.

4 Way
Cat. MS-4054 $26.95

6 Way
Cat. MS-4058 $34.95

Flameless Gas Hot Air Blower

NEW PRODUCT

A handy little unit for blowing hot air without the presence of a flame. Great for general heating and drying, shrinking heatshrink tubing and working with plastics etc. Uses butane gas, has piezo ignition, and adjustable temp.

- Refill with butane gas (NA-1020)

Cat. TH-1602 $29.95

AV Lead for Camcorders and LCD TV's

NEW PRODUCT

This lead is for connecting your camcorder or LCD TV to another AV device such as a video recorder or TV. It takes the 3.5mm 4 pole input/output jack and sends the signal to 3 RCA plugs.

Cat. WV-7345 $9.95

Exquisite Electronic Wine Corkscrew

A powerful but gentle electric corkscrew action to remove even the most difficult cork. This little beauty would make a magnificent present for any wine buff. 240V charger is supplied in an attractive gift box.

NEW PRODUCT

Cat. YS-5525 $99.95

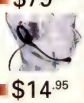
40 Channel UHF/CB Transceiver

- Open field range up to 5Km / Inner city range up to 1Km
- VOX function
- Requires 4 x AAA batteries

NEW PRODUCT

Cat. DC-1010 $79.95

Hands Free VOX Kit to Suit Above



Mains Charger to Suit

Cat. DC-1012 $14.95

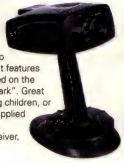
Cat. DC-1014 $14.95

2.4 GHz Wireless Cameras

B&W CMOS Wireless Camera Transmitter/Receiver

Take the hassle out of installing surveillance cameras, simply apply power, and the camera will transmit the image and audio, to the awaiting receiver. It features Infra-red LEDs mounted on the front to "See In The Dark". Great for monitoring sleeping children, or the poolside action. Supplied with mains plugpacks, camera, 3 channel receiver, and an A/V RCA cable.

Cat Price $269



SAVE $30

Cat. QC-3255 Introductory Price $239.00

Colour CCD Wireless Camera Transmitter/Receiver

Monitoring remote locations has never been easier or cheaper with this colour transmitting camera and 3 channel receiver. The receiver will accept up to 3 separate cameras and can be set to scan and individually display each camera. Great for home security, kindergartens, factories, surgeries etc.

Supplied is a 3 channel receiver, one transmitting camera, mains plugpacks, and an A/V RCA cable.

Cat Price $329

SAVE $40

Cat. QC-3260 Introductory Price $289.00

Titanium Subwoofer and Enclosure Deal

Ref: SC March 2003 includes a 10" Titanium Response 4Ω subwoofer, 25L sealed subwoofer enclosure, and a handful of other bits. Suited for car, or home theatre systems. It uses our 10" sealed subwoofer enclosure, and modifies the box to incorporate a speaker port. Liquid nails & plastic pipe not supplied.

NEW PRODUCT

The project includes the following parts:

1 x 10" Titanium Response Subwoofer	CS-2274	$99.00
1 x 25L Sealed Subwoofer Enclosure	CS-2520	$59.50
1 x 350gsm Acrylic Speaker Damping Material	AX-3690	$7.75
1 x 10" Steel Protective Grill and Grill Clamps	AX-3522	$7.95
2 x 65mm dia. Flared Speaker Ports	CX-2688	$9.90
	Total:	**$184.10**

Special Offer! Buy all these parts at one time in any Jaycar store, & we will give you the speaker ports and steel grill, absolutely FREE!

Buy All Together: $166.25 for the lot!
Save $17.85 **Cat. AA-0130**

AEI Economic Two Zone Alarm Controller

A compact and economic two zone alarm controller that is ideal for boats, caravans, granny flats and smaller houses. The controller has both instant and delayed zones and is fitted with a siren driver that can handle 2 x 8 ohm horn speakers. A relay output (NO) is also provided for driving a strobe light or other device. Exit and entry delays are built into the controller to allow legitimate entry. The controller's small size means that it can be easily hidden away. •Two alarm loops. One delayed and one instant •60 second exit delay and 30 second entry delay •5 amp relay output •12 - 16 VDC operation •Size 87(H) x 120(W) x 33(D)mm •Weight 145g

NEW PRODUCT

Cat. LA-5590 $39.95

Garage Parking Signal

This device uses an ultrasonic sensor, and as your car gets closer, the lights activate to indicate the distance remaining between the wall and your car. The unit can be calibrated for custom distance settings.

Requires 4 x D cell batteries. Not supplied.

NEW PRODUCT

Cat. LR-8866 $59.95

RF Modulator for Audio/Video

NEW PRODUCT

This modulator converts a Video and Audio signal to an RF or 'Antenna' type signal to connect directly into a TV which only has a TV aerial socket.

- Channels 0 and 1.
- Requires 12VDC @ 100mA.
- Use Plugpack MP-3002

Cat. LM-3872 $28.00

Desktop Clock with Thermometer and Hygrometer

Featuring solid metal construction, with a stylish high quality Satin Nickel plating, these pieces will compliment any desktop or table. Fully analogue, they feature a 12Hr clock, a thermometer range of -30 to +60°C (-20 - 140°F), and a full range hygrometer (0 - 100% Humidity). Supplied in a metal case with a foam insert. Two sizes available.

NEW PRODUCT

Vertical
Vertically Standing:
85 x 28 x 10mm
Cat. XC-0240

Horizontal
Horizontally Standing :
117 x 36 x 13mm
Cat. XC-0242

BOTH SIZES $49.95ea

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Video Doorphone

External unit has a B&W CMOS Camera with Infra-Red illuminators, to see your visitors in complete darkness. The internal unit features a 4" monitor with telephone handset. Speak to a visitor before letting them in. You can connect another monitor, or even 2 more to this unit. This unusual feature, normally only found on expensive professional units enables you to answer the door from virtually anywhere in the house/factory! Will also operate an electronic door strike (Cat LA-5078).

Was $299.50 Save $50

Cat. QC-3413 $249.50

Extra Receiver Available
Was $239.50 Save $40
Cat. QC-3415 $199.50

Wireless 6-Zone Home Security System

- Remote control or keypad activation
- 6 + 1 zone protection
- Internal siren with external siren output
- Hard wiring option if required

Was $449
Save $80

Extra wireless reed switch sensors are now also available Cat. LA-5464

Cat. LA-5460 $369.00

Super Speaker Sale!

Don't miss out on these great savings for March Madness. See Jaycar catalogue for details and specs.

1" Dome Tweeter
Was $19.95 **Save $4**
Cat. CT-2008 Now $15.96

1" RESPONSE Magnetically Screened Dome Tweeter
Was $20.95 **Save $4**
Cat. CT-2006 Now $16.95

3" RESPONSE Magnetically Screened Woofer
Was $27.95 **Save $4**
Cat. CW-2103 Now $23.95

4" RESPONSE Magnetically Screened Woofer
Was $32.95 **Save $6**
Cat. CW-2104 Now $26.95

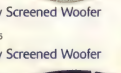
5" RESPONSE Magnetically Screened Woofer
Was $49.95 **Save $10**
Cat. CW-2102 Now $39.95

6.5" Paper Cone Woofer
Was $23.50 **Save $4.55**
Cat. CW-2105 Now $18.95

8" Paper Cone Woofer
Was $29.95 **Save $5**
Cat. CW-2110 Now $24.95

10" Paper Cone Woofer
Was $35.95 **Save $6**
Cat. CW-2119 Now $29.95

12" Paper Cone Woofer
Was $49.95 **Save $10**
Cat. CW-2125 Now $39.95



2.4GHz Wireless Audio and Video Sender with Remote Control Extender

- Powerful 10mW signal
- Composite video/audio input/output
- Includes RCA leads and mains plug packs

Was $199

SAVE $34

Cat. AR-1815 $165.00

Alarm/Entry Warning Systems Slashed

Each of these alarms/warning systems can be installed in just minutes. They are all self-contained, and run on 3 button cells (supplied). The modules and reed switch assemblies can all be mounted with the double sided tape (supplied).

Mini Door/Window Alarm

This small alarm module mounts on a window or door and is triggerd by a reed switch/magnet assembly when either a door or window is opened. Was $17.95 Save $8 **Cat. LA-5004** $9.95

Melody Mini Entry Alarm

This self-contained alarm provides an effective warning of entry by way of simple melody. One of twelve different melodies are cycled each time the alarm is triggered. Was $17.95 Save $8 **Cat. LA-5006** $9.95

Glass Break Mini Entry Alarm

This module can be used as either a glass breakage detector or as a door/window alarm. The alarm could be fixed to, say, a sliding glass door, and depeding on the level of protection you wanted. Was $19.95 Save $8 **Cat. LA-5008** $11.95

12VDC 130WRMS Car Sub Amp Module

Accepts line level inputs, and delivers 130WRMS into 4Ω or 165WRMS into 2Ω. Built in variable crossover and 180° phase switch.

SAVE $40

Was $179

Cat. AA-0514 Now $139.00

12VDC 240WRMS Car Sub Amp Module

240WRMS into 4 Ohms or 290WRMS into 2Ω. High and Line level inputs, variable Xover, three stage bass boost, level and phase controls.

Was $249

Now $199.00

SAVE $50

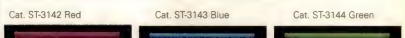
Cat. AA-0513

12" Colour Neon Tubes

NEW PRODUCT

Create great lighting effects in the car, boat, or home. You can mount the neon onto any flat surface, and 12-14VDC @ 250mA is all that is required to power them. They are housed in a tough acrylic tube with transparent end caps. Supplied with a 1.5m lead with a cigarette lighter plug. For home use, use our MP-3006 12V 450mA plugpack.

Cat. ST-3142 Red | Cat. ST-3143 Blue | Cat. ST-3144 Green



All colours $24.95 EA

12" Blacklight UV Neon Tube

NEW PRODUCT

Just like a blacklight at nightclubs, giving a Glow in the Dark effect, great for the car or bedroom. For home, use our MP-3006 plugpack. Current draw 250mA.

Cat. ST-3147 $24.95

12" Lightning Blue Neon Tube

NEW PRODUCT

This neon creates a continuous flow of twisting light that spirals along the tube. Touch the tube and the light attracts to your fingers for a more interactive light show.
For home, use MP-3006 plugpack.
Current draw 420mA.

Cat. ST-3148 $29.95

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Lower Prices on Smartmedia, Compact Flash and Multimedia Cards

Removable memory for Digital Cameras, PDA's, MP3 Players etc. Don't miss any of those golden moments, fulfil your digital storage needs.

Compact Flash		
16MB	Cat. XC-4771	$40.95
32MB	Cat. XC-4772	$53.95
64MB	Cat. XC-4773	$81.95
128MB	Cat. XC-4774	$132.95
256MB	Cat. XC-4778	$189.95
Smartmedia		
32MB	Cat. XC-4776	$44.95
64MB	Cat. XC-4777	$83.95
Multimedia		
32MB	Cat. XC-4786	$67.95
64MB	Cat. XC-4787	$114.95

SurfCam USB Web Camera

- 100K pixel colour CMOS camera
- Ideal for video conferencing and Home use
- Supplied with editing software

Was $49.95

SAVE $10

Unbeatable Value

Cat. QC-3220 Now $39.95

PC Security and Encryption Key

- Complete security and encryption control
- Small USB "Key" for control
- Password protection

Was $399

SAVE $100

Cat. XC-4838 Now $299.00

Save on Rechargeable Ni-Mh Batteries - March Only

SAVE $$$

		Normally	Buy 4+	Buy 10+
AAA 650mAh Nipple	Cat. SB-2444	$3.59ea	$3.15ea	$2.75ea
AA 1650mAh Nipple	Cat. SB-1700	$4.50ea	$3.95ea	$3.60ea
AA 1800mAh Nipple	Cat. SB-1705	$5.95ea	$5.25ea	$4.75ea
C 4500mAh Nipple	Cat. SB-2429	$14.95ea	$13.35ea	$11.70ea
D 8000mAh Nipple	Cat. SB-2449	$24.90ea	$22.35ea	$19.70ea
9V (8.4V) 200Ah	Cat. SB-2467	$14.95ea	$13.35ea	$11.70ea

Kodak Spindle CD- R Bulkpack

NEW PRODUCT

- 80 min, 700mB.
- 100 pieces.

Was $81.95 Save $12.00

Cat. XC-4719

Now $69.95

Standard 3mm LEDs 5-15MCD

Cat No	Colour	Normally	25+	100+
ZD-1740	Red	$0.25	$0.14	$0.10
ZD-1745	Green	$0.25	$0.14	$0.10
ZD-1750	Yellow	$0.25	$0.14	$0.10

3mm Bi Colour LEDs

Cat No	Colour	Normally	25+	100+
ZD-1739	Red/Green	$0.73	$0.40	$0.30

Standard 5mm LEDs 5-15MCD

Cat No	Colour	Normally	25+	100+
ZD-1710	Red	$0.33	$0.18	$0.12
ZD-1715	Green	$0.33	$0.18	$0.12
ZD-1720	Yellow	$0.33	$0.18	$0.12
ZD-1725	Orange	$0.33	$0.18	$0.12

5mm Bi/Tri Colour LEDs

Cat No	Colour	Normally	25+	100+
ZD-1734	Red/Green	$0.73	$0.40	$0.30
ZD-1735	Red/Green /Orange	$0.81	$0.45	$0.35

MASSIVE SAVINGS ON LEDs Don't Miss Out!

For all standard/multi-colour/flashing LEDs, the savings are for bulk quantities of one type only i.e. you must buy 25+ or 100+ of the one product to qualify for the discount.

5mm Flashing LEDs

Cat No	Colour	Normally	25+	100+
ZD1730	Red	$1.35	$0.70	$0.60
ZD1731	Green	$1.35	$0.70	$0.60
ZD1732	Yellow	$1.35	$0.70	$0.60

5mm UV LEDs

Cat No	Colour	Normally	25+	100+
ZD1792		$0.53	$0.25	$0.18

10mm LEDs

Cat No	Colour	Normally	25+	100+
ZD-1956	Red	$0.60	$0.30	$0.22
ZD-1957	Green	$0.60	$0.30	$0.22
ZD-1958	Yellow	$0.60	$0.30	$0.22

10mm Bi Colour LEDs

Cat No	Colour	Normally	25+	100+
ZD-1962	Red/Green	$1.00	$0.55	$0.47

10mm Flashing LED

Cat No	Colour	Normally	25+	100+
ZD-1965	Red	$1.70	$0.95	$0.80

Rectangular LEDs

Cat No	Colour	Normally	25+	100+
ZD-1760	Red	$0.35	$0.19	$0.15
ZD-1765	Green	$0.35	$0.19	$0.15
ZD-1770	Yellow	$0.35	$0.19	$0.15

All prices are per each

Buy in Bulk & Save up to 60%

***For all of these high brightness LED's, you have the flexibility to mix and match within the individual product groups. i.e. You can choose between colours and brightness, though they must all be from the same group ie: "3mm High Brightness" group.**

3mm High Brightness LEDs

Cat No	Colour	mCd	Normally	Buy 25+ Assorted*	Buy 100+ Assorted*
ZD-1752	Red	120	$0.42	$0.21	$0.17
ZD-1753	Red	900	$0.75	$0.38	$0.30
ZD-1757	Red	5000	$1.60	$0.80	$0.64
ZD-1754	Yellow	2000	$1.05	$0.53	$0.42
ZD-1758	Yellow	5000	$1.60	$0.80	$0.64
ZD-1755	Green	350	$0.81	$0.41	$0.32
ZD-1991	Green	3500	$3.45	$1.73	$1.38
ZD-1990	White	3000	$2.96	$1.48	$1.18

5mm High Brightness LEDs

Cat No	Colour	mCd	Normally	Buy 25+ Assorted*	Buy 100+ Assorted*
ZD-1792	Red	500	$0.53	$0.27	$0.21
ZD-1793	Red	1000	$0.69	$0.35	$0.28
ZD-1796	Red	3000	$1.00	$0.50	$0.40
ZD-1777	Red	6500	$1.10	$0.55	$0.44
ZD-1795	Yellow	160	$0.53	$0.27	$0.21
ZD-1778	Yellow	5000	$1.00	$0.50	$0.40
ZD-1794	Green	80	$0.53	$0.27	$0.21
ZD-1779	Green	6000	$5.95	$2.98	$2.38
ZD-1998	Blue	2000	$2.50	$1.25	$1.00
ZD-1999	Blue	3000	$3.00	$1.50	$1.20
ZD-1997	White	7000	$3.45	$1.73	$1.38

10mm High Brightness LEDs

Cat No	Colour	mCd	Normally	Buy 25+ Assorted*	Buy 100+ Assorted*
ZD-1970	Red	1600	$0.70	$0.33	$0.26
ZD-1974	Red	3000	$0.95	$0.55	$0.45

Prices correspond to individual products, when purchased in a total quantity of above the required volume.

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4 Amp Sealed Lead Acid Battery Charger

NEW PRODUCT

Plugs into a 240V mains socket and supplies 12V at 4 amps (fast) 300mA (trickle), to heavy duty battery clips. Switches to float (trickle) charge when full.
Recommended battery size is 20 to 40AH sealed or low maintenance lead acid. Features reverse polarity buzzer & charge status LED.

Cat. MB-3528 $99.00

100mm Cable Ties

Bargain pack of 100 cable ties

NEW PRODUCT

Cat. HP-1230 $2.95

Experimenters Heatsink

NEW PRODUCT

We landed these useful heatsinks as a surplus at a great price, get them while they last. Great for prototypes, made of aluminium and offer a number of applications.

•Size: 110(L) x 87(W) x 13mm(fins).

Cat. HH-8562 $4.95

Wafer Card with PIC16F84A + 24LC16B Inbuilt

NEW PRODUCT

Popular with Smart Card programmers

1+ $19.95
10+ $17.70
25+ $15.70

Cat. ZZ-8800

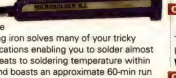
Computer Tool Kit

Perform minor repairs and upgrades to your computer with this handy tool kit. It includes an excellent range of assorted driver bits, a ratchet handle, a small torch, insulated tweezers and much more. See Cat Pg 216 for details.
Was $29.95

SAVE $10

Cat. TD-2047 Now $19.95

Battery Powered Soldering Iron



Powered by just 3 x 1.5V AA batteries, this quality

Japanese made
6-watt soldering iron solves many of your tricky soldering applications enabling you to solder almost anywhere. It heats to soldering temperature within ten seconds and boasts an approximate 60-min run time. Requires 3 x AA batteries (not included). Includes 0.25mm tip, cap and tip remover
Was $74.95

SAVE $10

Cat. TS-1286 $64.95

12V 5Amp Solar Battery Charger Regulator PCB Module

NEW PRODUCT

When charging batteries from a solar panel you need to be sure you do not overcharge the battery. With this unit you can charge at 13.8Volts up to 5 Amps. It is supplied as a module you can mount to suit your application.
•Suitable for batteries 2 to 100AH.
•Input Voltage: 12 - 20VDC From Panel (suited for 12V panels)
•Output Voltage: 13.8VDC •Size: 80(H) x 70(W) x 20(D)mm.

Cat. MP-3127 $29.95

New Cases

NEW PRODUCT

Bulkhead Plastic Mount Case

Base mounts to case by 4 self tapping screws (inc).
•Measures: 72 x 50 x 63mm

Cat. HB-6081 $8.95

Bulkhead Plastic Mount Case with Clear Front/Top

This case has a clear plastic front/top plate that allows you to view the contents of the box. •Measures: 120 x 70 x 30mm

Cat. HB-6082 $9.95

Low Profile Hangable Case with Clear Front

This case is thin enough to hang on the wall with the clear section in the front allowing easy viewing of the contents. Ideal for LED and display type projects. •Measures: 130 x 130 x 17mm •Window/ internal size: 108 x 108 x 15mm

Cat. HB-6083 $12.95

Imac Type Blue Jiffy Box UB5

NEW PRODUCT

Utilizing the same brilliant design as the others in the series, this Jiffy box takes things one step further. It's colour is a semi transparent Imac type blue, to add a new look to your latest project.
Size 83 x 54 x 31mm

Cat. HB-6004 $3.40

70/100A Circuit Breaker For Cars 12/24V

Rugged and reliable devices suitable for car sound installations. Each device will trip within a few milliseconds under short circuit conditions, and feature protective rubber caps, test button and gold plated terminals.
Was $32.95 Save $10
70 Amp Cat SF-2265 100 Amp Cat SF-2266

Now $22.95ea

Beginners Guide to Pic Micro

•Covers Architecture and Microcode of PICs
•Includes MPLAB Development Software
Was $79.95

SAVE $40

Cat. BJ-6050 $39.95

Cigarette Lighter Lead

3 amp fused Cigarette lighter plug to bare ends. Approx 450mm long
Was $2.95 Save $0.95ea

Now 10 for $20

Cat. PP-1995

Great Savings on these Plugpacks

9VDC 850mA

Terminates to a 1.75mm DC Plug
Was $14.95 Save $10

Cat. MP-3009 Now $4.95

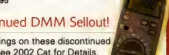
10VDC 1.2A

Terminated to a 2.1mm DC Plug
Was $16.45 Save $10

Cat. MP-3005 Now $6.45

25% Silver Heatsink Compound

NEW PRODUCT



Contains 25% Silver for more efficient heat transfer than standard compounds. Please note that Silver Heatsink Compound does conduct electricity and care should be taken when being used.

Cat. NM-2013 $4.95

Discontinued DMM Sellout!

Great Savings on these discontinued DMM's. See 2002 Cat for Details. Quantites are strictly limited, don't miss out!

PC Interface DMM

•Auto Ranging •Temperature
•Back light •Capacitance
Was $129.95 Save $30

Cat. QM-1350 $99.95

Auto Ranging DMM

•Bar graph •Data Hold
•Back Light •Probe Lockout Shutters
Was $89.95 Save $15

Cat. QM-1533 $74.95

Open Jaw DMM

•Twin Display •Frequency
•Duty Cycle •Capacitance
Was $119.50 Save $25

Cat. QM-1545 $94.50

4 in 1 DMM

•Sound Level (SPL)
•Light (Lux)
•Humidity
•Temperature
Was $99.50 Save $20

Cat. QM-1580 $79.50

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PC Board for 12V LED Bayonet Style Lamp Kit

- Ref: Silicon Chip March 2003
- Replace 12V filament lamps with LEDs
- PCB only supplied for flexibility

Note: Finished kit pictured. LEDs, components and bayonet lamp not included

NEW PRODUCT

Cat. KC-5349 $8.95

Serial PIC Programmer Kit

This kit can be used to interface with our Smart Card Programmer Kit to the right, with the adaptor cable described in Silicon Chip March 2003. Parallel port connection. Kit supplied with PCB and all electronic components.

NEW PRODUCT

Cat. KD-6062 $42.50

Smart Card Reader / Reprogrammer Kit

Ref: Silicon Chip 01-03

- Exclusive to Jaycar Electronics
- Smart cards sold separately

NEW PRODUCT

Cat. KC-5342 $29.95

50 Metre IR Light Barrier Kit

NEW PRODUCT

Covering a distance of up to 50 metres this light beam relay is ideal for protecting areas that have wide entrances, including driveways, shops, offices and storerooms, etc. Once the beam is broken the relay will trigger and onboard LED will illuminate. Kit includes Kwik Kit PCB and all electronic components.

Cat. KG-9196 $49.95

Ten Channel Infrared Remote Control Kit

NEW PRODUCT

Select any one of ten devices with this unique infrared remote control. Pressing a button on the transmitter will turn on the corresponding solid state relay on the receiver board and turn off the previously selected relay. An eleventh button turns all relays off. Supplied with PCB and all electronic components.

Cat. KG-9198 $49.95

SENSATIONAL NEW VERSION OF THE ETI-480

SC-480 50W Amplifier Module Kit Version 1

Ref: Silicon Chip 01-03 and 02-03

- Improved design from the ETI-480
- Uses TO-218 power transistors
- Supplied in short form with PCB and all electronic components
- Heatsink not included Use HH-8555

Cat. KC-5345 $44.95

Improved design and reliability

SC-480 50W Amplifier Module Kit Version 2

Ref: Silicon Chip 01-03 and 02-03

- Improved design from the ETI-480
- Uses TO-3 power transistors
- Supplied in short form with PCB and all electronic components
- Heatsink not included Use HH-8550

Cat. KC-5346 $44.95

28-0-28V Centre Tapped Transformer

Suits KC-5347 power supply kit

Cat. MM-1095 $39.95

Power Supply Kit to Suit SC-480

- Supplies +/- 40V rails to the amplifier module
- Also provides +/- 15V supply rails for a preamplifier
- Supplied in short form
- Requires 56V centre tapped transformer use MM-1095

Cat. KC-5347 $29.95

LOOKING FOR AN OLD KIT?

If you are, we may have it in our Kit Back Catalogue. The 'Kit Back Catalogue' range is listed on the Jaycar website (under Kits & Projects) and can only be purchased via the website "www.jaycar.com.au" or Techstore (i.e. not the Jaycar stores).

STORE LOCATIONS / CONTACT NUMBERS:

All prices valid to end March 2003

Jaycar ELECTRONICS

MAIL ORDERS - FREE POST TO:
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Free Call For Orders: 1800 022 888 Enquiries: (02) 9741 8538 Fax: (02) 9741 8559

EMAIL ORDERS: techstore@jaycar.com.au

Post $10 to $24.99:	$4.40
Post $25 to $49.99:	$5.50
Post $50 to $99.99:	$7.70
Post Over $100:	$8.80

Road Freight Anywhere In Australia (up to 20kg):	$15.50
Express Post Max 500g:	$7.70
Express Post Max 3kg:	$11.00

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- Max weight 3KG (inc cubic) $11 • No dangerous goods
- Max weight 5kg (inc cubic) $16.60 • Stock & availability
- Orders must be received before Midday E.D.S.T.

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ACT - CANBERRA
• 121 Wollongong Street Fyshwick • Ph: (02) 6239 1801
TAS - HOBART
• 140 Campbell St. Hobart • Ph: (03) 6231 5877

SA - ADELAIDE
• 191-195 Wright Street • Ph: (08) 8231 7355
VIC - COBURG
• 295 Sydney Rd • Ph: (03) 9384 1811
FRANKSTON
• 5/6, 424-426 Nepean Hwy. • Ph: (03) 9781 4100
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• 190 Mooraboool St. • Ph: (03) 5221 5800
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• Shop 2.45 A'Beckett St • Ph: (03) 9663 2030
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• 141A Maroondah Hwy • Ph: (03) 9870 9053
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• 887-889 Springvale Rd Mulgrave. • Ph: (03) 9547 1022

WA - PERTH
• 326 Newcastle St Northbridge • Ph: (08) 9328 8252
QLD - ASPLEY
• 1322 Gympie Rd. • Ph: (07) 3863 0099
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PRODUCT SHOWCASE

The ultimate hard disk music storage system?

Looking for somewhere to store (and retrieve) all your music? Linn Products have a solution – if you're prepared to pay for it!

The Kivor Index music library is a storage/retrieval and playback hard-disk-based system that can be used as a stand-alone unit or together with other Knekt Kivor products.

It provides up to 500 hours of full bandwidth, pitch accurate hard disk music storage and allows up to eight users to have concurrent access to high quality, full bandwidth music in a multi-room system or a hard disk component source in any audio system.

Whether you have a huge library of LPs or CD discs, or like to download MP3 music, the Kivor Index hard disk records and creates playlists of your favourite tracks by genre, artist, mood or date. Available in two configurations, the Kivor Index provides either 250 or 500 hours of storage that can be increased up to tenfold when using compressed audio.

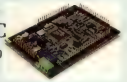
Music is simply loaded into the Kivor Index via its integrated CD-ROM and a built-in modem downloads Internet material for 'manipulation' on Linntek, Linn's PC set up and control utility software.

Available in either black or silver, the Linn Kivor Index music library is rack mountable for installation with any multi-room amplification system.

Covered by a two-year parts and labour warranty, the Kivor Index (250 hours storage) has an RRP of $14,999 and the Kivor Index (500 hours storage) has an RRP of $19,999.

Contact:
Linn Products
Ph: 1800 642 922
email: info@audioproducts.com.au

Foxie low-power SBC



The LP3500 Fox low-power single-board computer is intended for applications where power is limited, such as in portable, hand-held, battery-powered, and remote monitoring systems.

It features built-in analog and digital I/O and consumes less than 20mA when fully operational and less than 100µA in power-save mode

It has 25 industrialised I/Os plus a relay and has eight analog/digital converter inputs with programmable gain. Six serial ports are provided (1x RS-485, 3x RS-232 and 2x TTL) and there are optional peripherals including keypad/display, serial flash, etc.

Contact:
Dominion Electronics
Ph: (02) 9906 6988
website: dominion.net.au

330-1500µF, ultra-low ESR tantalums

A new series of solid tantalum chip capacitors from Vishay Intertechnology, Inc. features ultra-low equivalent series resistance (ESR) and high capacitance values in new "E" and "R" case sizes.

The Vishay Sprague conformal-coated 597D multi-anode capacitors provide increased reliability and improved reception in DC-DC conversion, line cards, mother boards and power supply applications in end products including test equipment, PCs and base stations.

The devices' ultra-low maximum ESR values range from 13mΩ to 35mΩ at +25°C and 100kHz. Capacitance values range from 330µF to 1500µF with standard tolerances of ±10% and ±20%, and working voltage ranges from 4-10VDC. Maximum current leakage ranges from 27µA to 68µA, and the maximum dissipation factor is 6% at +25°C and 120Hz.

Contact:
Vishay Intertechnology Inc
PO Box 231, Sanford, ME 04073 USA
Seaford Vic 3198
Ph: (0011 1) 207 490 7240
website: vishay.com

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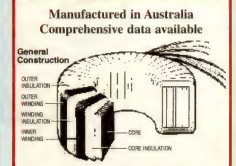

Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Cellular call diverter: 50-80% telephone bill savings claim

A Gold Coast-based telecommunications company, Powertec, has announced the development of a new Cellular Diverter that they claim will save users between 50% and 80% off their regular landline and mobile telephone accounts.

The Managing Director of Powertec, Mr Ray Smith, says the new diverter revolutionises the manner in which small and/or home business operators are charged for landline calls diverted to mobiles. "At present whenever a home or office telephone call is diverted to a mobile phone the owner pays charges for the diversion, in conjunction with the caller paying costs as well," said Mr Smith. "The new Powertec CellularDiverter turns that landline component into a mobile call, so users can then benefit from special mobile-to-mobile rates," he said.

"This means that a 10 minute diverted call which would normally cost up to $2.50 will now only cost 20 cents," he added. "Any business making calls to mobiles or receiving calls from their own mobiles can take advantage of the new cost saving system even when they do not use the diverter," he said.

Mr Smith says the new Powertec Cellular Diverter is the result of more than two years of research and development, at a cost of thousands of dollars. He says the device is Australian compliant and has patents pending. They are used in conjunction with the Ericsson Fixed Cellular Terminal which was released on the Australian market, late last year.

Powertec is offering to loan the system to approved customers at no cost to prove that the technology is beneficial in saving on phone bills for small business and home users.

Contact:
Powertec Telecommunications
19 Short St, Southport Qld 4215
Ph: 1800 MOBILE
website: powertec.com.au

Increased airflow inside racks and enclosures

American Power Conversion (APC) has available a new compact air distribution unit that increases airflow inside racks and enclosures.

APC's NetworkAIR Rack Mounted (RM) Air Distribution unit works in tandem with an existing precision air conditioning system in enclosed environments to pull air from beneath the raised floor directly into the rack enclosure, before it can mix with room air.

It eliminates dangerous hot spots in data centres by boosting the conditioned air volume within the rack itself and improving air delivery in poor static pressure areas. In environments without raised floors, the NetworkAIR RM Air Distribution unit uses air from under and around the bottom of the rack or enclosure where the air is coldest. This boosts the amount of air supplied to ensure the necessary amounts of airflow to equipment.

Contact:
American Power Conversion (APC)
Ph: 9955 9366
website: apcc.com

Need more "oomph" from your wireless LAN?

When your wireless LAN needs more output, these cards will do the job. They represent the next generation of wireless equipment offering both robust construction and a choice of a both high power (200mW) and standard (100mW) models.

They are ideal for wireless ISPs.

The detachable external antenna further enhances their overall performance. If you use them with a high gain antenna, make sure you don't exceed the 4W EIRP legal limit.

They support both peer-to-peer and infrastructure communications and are usable with WiFi (WECA) certified products. Operating systems supported include Win 95, 98, 2000, NT, ME and XP. Memory size is 128K x 16 SRAM and 128K x 8 flash ROM.

Contact:
Microgram Computers
Unit 1/14 Bon Mace Cl, Berkeley Vale NSW 2261
Ph: (02) 4389 8444 Fax: (02)4389 8388
website: microgram.com.au

TDK's one-chip smart card terminal controller

TDK Semiconductor Corp. now offers the 73S1121F smart card terminal controller – said to be the first true system on a chip for smart card terminals.

The new low-cost device integrates all the functionality for implementing a complete range of smart card terminals for network access security, e-purse terminals, payphones, vending machines and inexpensive POS terminal applications. It includes an 8052 processor, a USB interface, two built-in smartcard interfaces with a dedicated hardware ISO7816 UART, multiple development software layers, extensive I/Os, 64KB of Flash, 4KB of user-RAM and a PIN pad interface all on a single chip. This solution will significantly reduce cost and component count for implementing smart card terminals.

Contact:
Adilam Electronics Pty Ltd
Ph: (03) 9737 4900
Fax: (03) 9737 4999
website: adilam.com.au

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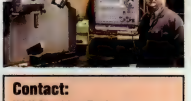
Controller upgrade brings new life to old machine

JAR Engineering faced the prospect of scrapping their Kasuga Machining Centre while the core of the CNC machine was still fully functional. The problem: the Kasuga controller was: "Old and slow – a case of a still young body under the direction of an old, slow brain!" said Roy Milan of JAR.

But scrapping the machine and buying a new system would have involved a large capital investment. Instead, JAR Engineering contacted H & H Machine Tools and investigated the possibility of a controller transplant. The result: the Kasuga is now working at double the previous feed rate.

Mr Milan says: "The system used to operate in a jerky, stop, start motion. The new Fidia controller provides a continuous smooth movement and reads at a very high rate of knots. We are frequently recording savings of $500 a day or higher —savings that will rapidly pay out the upgrade cost."

He adds that his company has found the Fidia controlled machine "very user friendly, with the need for operator training minimised."



Contact:
H&H Machine Tools
Ph: (03)9719 7729,
Fax: (03) 9719 7298
email: gmann@h-h.com.au

Building The

Our State-of-the-art Portable Public Address Amplifier

Last month we introduced this innovative compact and powerful Portable Public Address amplifier based on the Philips TDA1562Q 70W class-H power IC. This month, we conclude with the description of the power supply, cabinet and PC board construction and the parts list.

As noted last month, the power supply is effectively a battery charger with the 7 amp-hour SLA battery permanently connected.

Since the charger has other uses and could be used in any situation where a float charger is required, we are describing its circuit operation and construction separately, on pages 64 and 65.

We're also detailing the box construction separately – you'll find this on pages 66 and 67. While we give detailed dimensions, this is not the only approach possible. We're sure some readers will come up with completely different ideas for the enclosures.

Construction

The PortaPAL PA Amplifier is housed in a timber cabinet measuring 480 x 280 x 240mm which is covered in speaker carpet. Corner protectors, a speaker grille, a speaker stand socket and a handle are included.

The electronics is accommodated on four PC boards: the microphone PC board coded 01103032 (64 x 73mm), the auxiliary PC board coded 01103033 (109 x 35mm) and the main PC board coded 01103031 (199 x 90mm). These are mounted on an L-shaped metal bracket, the reverse of which becomes the front panel.

The charger PC board coded 01103034 (132 x 66mm) mounts on the side of the box with its indicating LEDs protruding through the front panel.

You can begin construction by checking the PC boards for shorted tracks or any breaks in the copper patterns. Also check that the holes are drilled to suit the components. In par-

PortaPAL

FEATURE PROJECT

PART 2: BY JOHN CLARKE & LEO SIMPSON

ticular, check the corner mounting hole sizes and the holes for the pots, RCA, 6.35mm jack and XLR sockets.

Microphone board

Assembling the microphone PC board is simple, as shown in Fig.1. Begin by installing the LM833 op amp (IC1), together with all the resistors and capacitors.

Use the resistor colour code and capacitor code tables to guide you in selecting the correct values, and/or check the resistor values with a digital multimeter. Also, the electrolytic capacitors need to be oriented with the polarity shown.

Note that the 10kΩ resistors and 10µF capacitor marked with an asterisk (*) are optional for powering electret microphones. These components are not needed for dynamic microphones but will not do any harm to a dynamic mic if you regularly swap microphones.

There are a couple of PC stakes required to be installed for test points TP1 and TP2.

Next, insert the 90° 6-way pin header into the PC board as shown.

Before mounting the two XLR sockets, screw the M3 x 10mm screws into the mounting pillars from the back of the socket and then secure the M3 tapped 6mm long spacers from the front side of the sockets. Then mount the XLR sockets directly into the PC board holes provided.

Main PC board

The main PC board accommodates all the potentiometers and the TDA1562Q power amplifier module. Its component layout is shown in Fig.2.

Apart from the charger/supply board, everything mounts on an L-shaped bracket, the opposite side of which also acts as the front panel. Here everything is assembled, ready for placing inside the enclosure. Aaah . . . the enclosure. Did we forget to mention you have to build that too?

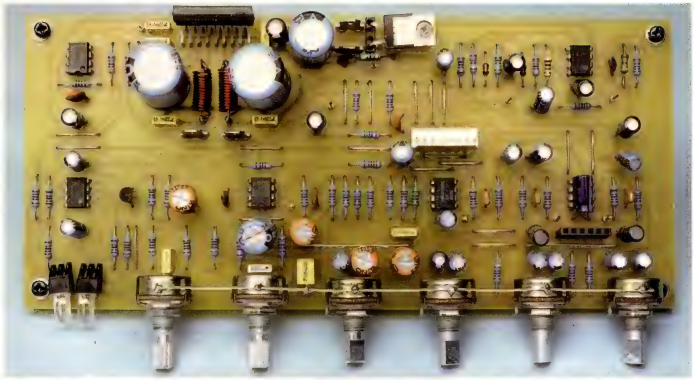
You can start its assembly by installing all the links, the resistors and then the ICs but not the TDA1562Q.

The 2.2Ω 1W resistors need to have an over-wind of 16 turns of 0.5mm diameter enamelled copper wire. These windings are shown on the circuit published last month, as L1 & L2.

Start with a short length of 0.5mm copper wire, strip and tin one end and solder it to one end of the 2.2Ω resistor. Then wind on 16 turns. Strip and tin the other end and solder it to the other end of the resistor. Repeat the process for the second 2.2Ω resistor. Then solder each resistor into the PC board.

Insert all the PC stakes used for the test points and also the PC-mount spade connectors. Mount the capacitors as shown with the electrolytics marked as polarised with the correct orientation.

Electrolytics marked BP (ie, non-polarised) can be inserted either way. Note also that the 10µF capacitor near



The main PC board shown here without the heatsink attached. Note the inductors wound over the resistors (near IC9).

IC2 must be bent over the top of IC2. This is to allow clearance when the microphone PC board is plugged into the header socket.

Insert the 6-way and 8-way headers, as shown. Transistor Q1, diodes D1 and D2 and the power amplifier (IC9) can be inserted. IC9 is positioned with the centre-line of its mounting holes exactly 12mm above the top face of the PC board. Be sure to solder all the pins of the amplifier and take care not to have any of the pins shorted.

Diode D3 is mounted onto a 6mm spacer and secured with a nylon screw and another 6mm tapped spacer on the underside of the PC board.

The nylon screw is required to prevent the tab of the diode shorting to the metal panel when it is finally assembled.

The two LEDs are mounted using LED mounts. The LEDs are inserted into the mounts from the front and the leads bent over at 90° within the mount before being inserted into the PC board. Be sure that the orientation is correct before bending the leads.

Finally, the potentiometers can be installed – take care to place each one in its correct position. The potentiometer bodies are all tied together with a length of 0.8mm tinned copper wire soldered to the top of each body. It is difficult to solder to the passivated metal, so you will need to scrape away the passivation coating (with a knife or screwdriver) before soldering the wire. The wire is then connected to the PC stake adjacent to the 330nF earthing capacitor.

Place a dab of red paint or nail polish next to the positive spade lug near the 22Ω resistor and the TP GND PC stake. This is for easy identification when connecting the supply wires.

Auxiliary board

The auxiliary PC board carries the

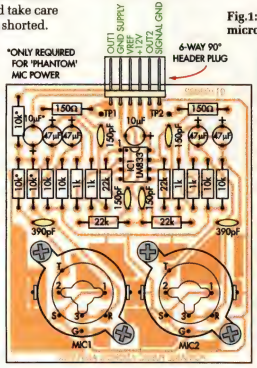
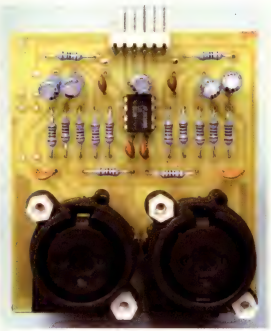


Fig.1: PC board overlay and same-size photo of the microphone input board.



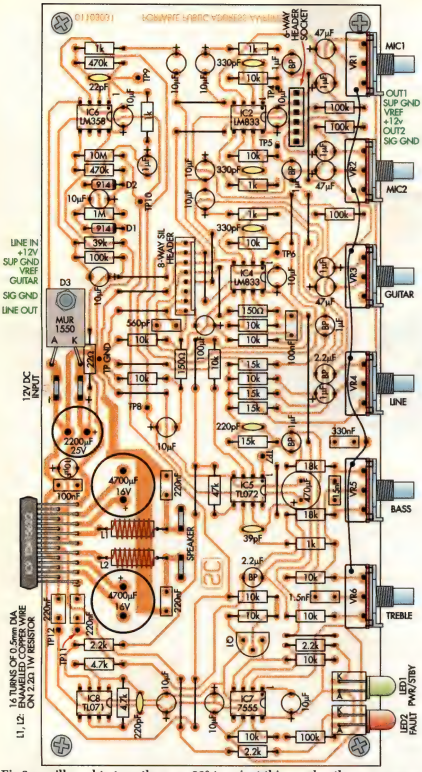


Fig.2: you'll need to turn the page 90° to orient this overlay the same way as the photo adjacent but between the two you should have no problems assembling the main PC board.

four RCA sockets and the jack sockets. Its component layout is shown in Fig.3. First, install all the resistors and the TL071 (IC3) op amp. Then insert the capacitors, again taking care with the polarity of the electrolytic capacitors. The 6.35mm jack sockets and the stereo RCA sockets are directly mounted onto the PC board. An 8-way pin header is mounted with the orientation shown. Finally, install the PC stake for the test point, TP3.

Support bracket

The bracket which supports the amplifier also doubles as the front panel. It is made from 195 x 240 x 1.5mm aluminium, bent at 90° to form an L-shape.

Dimensions of the panel, hole positioning and sizes are shown in Fig.4. The panel can be drilled and the larger holes cut before the panel is bent and the label attached.

We expect that if you purchase a kit, the panel will already be drilled and bent with a screen printed artwork. Those building from scratch will need to prepare the panel as shown with a dress panel attached to the L-shaped bracket.

The dress panel artwork (like the PC board artwork) can be downloaded from the SILICON CHIP website, **siliconchip.com.au** and printed, then glued to the aluminium panel.

Place nuts on all the pot bushes for the main board and then mount the board on M3 tapped 6mm standoffs, with M3 x 6mm screws and star washers. The standoff beneath D1 is secured in place with an M3 nut and star washer. Secure the pots with nuts on the outside of the panel.

The holes in the main heatsink can be drilled as shown in Fig.6. Apply a smear of heatsink compound on the face of the power amplifier and attach the heatsink to the baseplate with M6 screws into the heatsink mounting screw points. Then attach the amplifier to the heatsink with two M3 x 15mm screws, two flat washers and two nuts.

Attach the auxiliary board to the front panel by first fitting fibre washers onto the 6.35mm jack socket bushes and then mating them up the relevant panel holes; secure with the nuts. The RCA stereo sockets are secured with M3 x 6mm screws tapped into the plastic mounting pillars.

Plug the microphone board pin header into the control PC board socket and push the sockets into the front panel holes. Secure with M3 x 6mm screws into the 6mm standoffs already attached to the XLR sockets.

Make up a lead that connects the 8-way pin header sockets using 8-way rainbow cable. This connects the auxiliary board to the main board. Make sure the orientation is correct, with no twist in the wiring.

Power switch S1, the fuseholder and the 3-pin DIN socket can now be attached. The DIN socket is secured with M3 x 6mm screws, star washers and nuts.

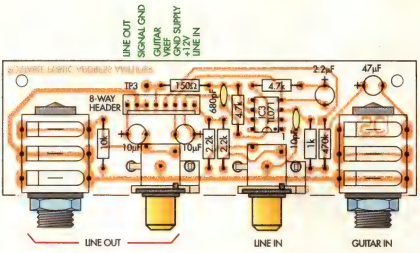


Fig.3: the auxiliary PC board has the line in/out and guitar input sockets – it connects to the main board via the 8-way header.

Connecting the boards

Fig.5 shows the wiring to the boards, battery and speaker. The battery and speaker connections are run in 7.5A figure-8 wire and crimp plugs. Use the lengths detailed on the diagrams for the charger and Fig.5.

Be sure to use blue crimp connectors for the negative lead connections and red connectors for the positive leads. That way, there is less chance of wrong polarity connections.

Also note that the amplifier power leads should be connected to piggy-back connectors for the battery terminals so that the charger leads can also be connected to the battery.

Making the cabinet

The box is made using 16mm Medium Density Fibre board (MDF) or craftwood and 16 x 16mm Meranti for the cleats.

Because many home constructors may not have precision woodworking equipment (nor skills!) we have described the box construction in detail in the separate panel – see pages 66-67.

Once the box is completed you can

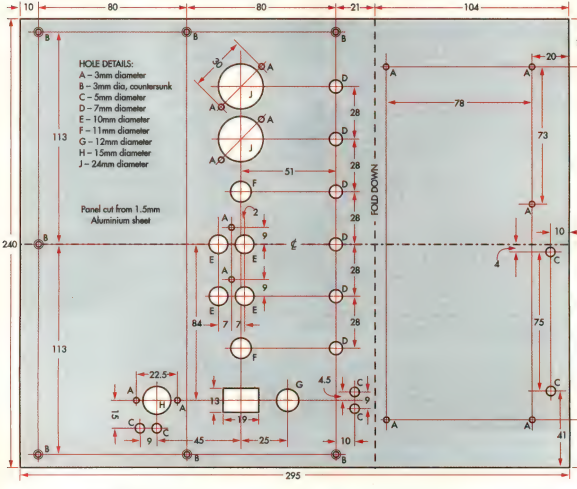


Fig. 4: this drilling template should help you with the front panel/ amplifier bracket.

Parts List – PortaPAL PA (Main Section)

1 microphone input PC board coded 01103032, 64 x 73mm
1 auxiliary input PC board coded 01103033, 109 x 35mm
1 control PC board coded 01103031, 199 x 90mm
2 450 x 900 x 16mm sheets of MDF board or craftwood
1 4m length of 12 x 12mm Meranti
1 195 x 240mm sheet of 1.5mm aluminium for panel
1 aluminium vent strip, 240mm long 15 x 12mm channel with holes or slots (eg, slotted shelf support strip)
1 200mm (8") 4Ω coaxial loudspeaker (Altronics C 2006)
8 speaker box corners, 55 x 35 x 35mm
1 speaker box "top hat" stand socket (Altronics C 3602)
1 200mm speaker grille (Altronics C 3708)
1 strap handle (Altronics C 3660)
1 1m x 1.8m length of speaker box carpet (Altronics C 3530)
1 heavy duty heatsink 110 x 33 x 72mm (Altronics H 0560)
1 M205 fuse holder (Altronics S 5992)
1 7.5A M205 fuse (F1)
4 blue knobs
2 grey knobs
3 16mm PC-mount 10kΩ log pots (VR1-VR3)
1 16mm PC-mount 5kΩ log pot (VR4)
2 16mm PC-mount 100kΩ linear pots (VR5,VR6)
1 SPST 6A rocker switch (S1)
2 6.35mm PC-mount jack sockets (Altronics P 0073)
2 stereo PC-mount RCA sockets (Altronics P-0210)
2 PC-mount XLR/6.35mm jack socket without locking tab (Altronics P-0960)
1 6-way header connector with 90° bend pins (2.54mm spacing)
2 8-way header connectors with straight pins (2.54mm spacing)
2 8-way header sockets (2.54mm spacing)
1 6-way PC-mount header socket (2.54mm spacing)
2 piggy-back 6.3mm crimp connectors
7 red female 6.3mm spade lug crimp connectors
5 blue female 6.3mm spade lug crimp connectors
4 6.3mm spade PC board connectors with 5mm pitch PC lugs (Altronics H 2094)
10 6mm tapped standoffs
10 M3 shakeproof washers
2 M3 flat washers
3 M3 nuts
10 M3 x 6mm screws
2 M3 x 15mm screws (for amplifier to heatsink connection)
4 M3 x 10mm screws (for 6mm standoffs on XLR sockets)
1 M3 x 20mm nylon screw (for diode D3 mounting and PC board mounting point)
2 M6 x 15mm screws (to secure heatsink to baseplate)
6 4G x 16mm countersunk wood screws for securing control panel and charger PC board
4 6G x 10mm cheese-head wood screws for mounting loudspeaker
4 6G x 20mm to mount speaker stand socket
3 6G x 30mm countersunk wood screws to secure MDF battery cover
2 8G x 25mm cheese-head wood screws to mount handle
32 4G x 16mm countersunk wood screws to mount corner protectors
2 5G x 20mm countersunk wood screws to mount aluminium vent strip
1 500mm length of 0.5mm enamel copper wire
1 2m length of 7.5A rated figure-8 wire
1 600mm length of 0.8mm tinned copper wire
1 120mm length of 8-way rainbow cable

Semiconductors

3 LM833 op amps (IC1,IC2&IC4)
1 TL072 op amp (IC5)
2 TL071 op amps (IC3,IC8)
1 LM358 op amp (IC6)
1 7555 CMOS timer (IC7)
1 TDA1562Q power amplifier (IC9)
1 BC337 transistor (Q1)
2 1N914, 1N4148 diodes (D1,D2)
1 15A diode (MUR1550 or similar T0-220 package) (D3)
2 5mm high brightness red LEDs (LED1,LED2)
2 PC board LED mounts (Altronics H 1543)

Capacitors

2 4700μF 16V PC electrolytic
1 2200μF 25V PC electrolytic
2 100μF 16V PC electrolytic
8 47μF 16V PC electrolytic
14 10μF 16V PC electrolytic
2 2.2μF BP* electrolytic
1 2.2μF 16V PC electrolytic
4 1μF 16V PC electrolytic
5 1μF BP* electrolytic
1 330nF MKT polyester
4 220nF MKT polyester
1 100nF MKT polyester
2 15nF MKT polyester
2 1.5nF MKT polyester
1 680pF ceramic
1 560pF ceramic
2 390pF ceramic
3 330pF ceramic
2 220pF ceramic
4 150pF ceramic
1 39pF ceramic
1 22pF ceramic
1 10pF ceramic

** BP (bipolar) capacitors are also known as NP (non-polarised)*

Resistors (0.25W, 1%)

1 10MΩ	1 1MΩ	3 470kΩ	5 100kΩ
1 47kΩ	1 39kΩ	2 22kΩ	2 18kΩ
4 15kΩ	21 10kΩ	4 4.7kΩ	5 2.2kΩ
8 1kΩ	5 150Ω	2 2.2Ω 1W	

Miscellaneous

PVA (timber) adhesive, contact adhesive, black paint, Bag of TEK particle board screws (for box assembly)
Optional: 3-pin mains socket, panel mounting – not connected but mounts inside bottom of box to act as a storage holder for plugpack when not in use.

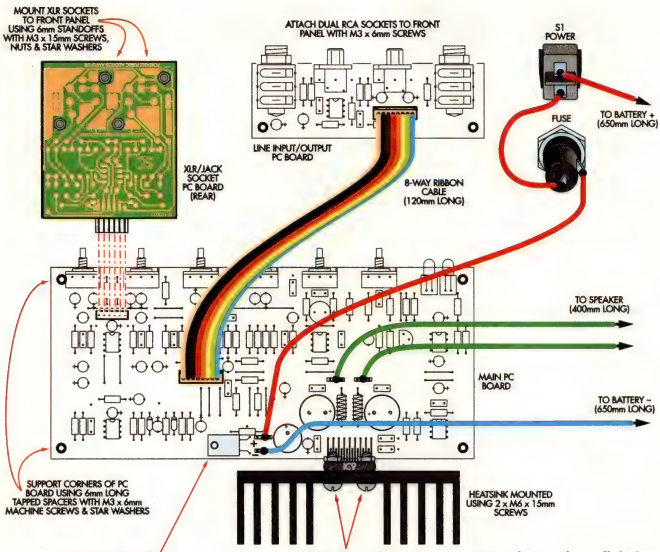


Fig.5: when you have all the boards assembled, connecting them together is as simple as following this diagram.

Parts List – PortaPAL SLA Float Charger

1 SLA battery charger PC board coded 01103034, 132 x 66mm
1 16VAC 1.5A plugpack 3-wire earthed type (Altronics M 9332)
1 PC board fin heatsink 84 x 24 x 28mm (Altronics H 0668)
1 12V relay with 6A contacts (RELAY1) (Altronics S 4160A)
1 3-pin 180° DIN plug
1 3-pin 180° DIN chassis socket
2 5mm high brightness red LEDs (LED3, 4)
2 PC board LED mounts (Altronics H 1543)
4 6.3mm spade PC board connectors with 5mm pitch PC lugs (Altronics H 2094)
2 M3 x 6mm screws (for DIN socket)
2 M3 x 10mm screws (for heatsink)
4 M3 nuts
4 3mm star washers
4 4G x 16mm countersunk wood screws for securing charger PC board
1 50mm length of 0.8mm tinned copper wire

Semiconductors
1 LM317T regulator (REG1)
2 BC337 transistors (Q2,Q3)
9 1N4004 1A diodes (D4-D12)

Capacitors
1 4700µF 25V PC electrolytic
1 4700µF 16V PC electrolytic
1 470µF 25V PC electrolytic
2 10µF 16V PC electrolytic

Resistors (0.25W, 1%)
2 2.2kΩ 3 1kΩ 3 470Ω 1 120Ω
1 220Ω 0.5W, 5%
1 1Ω 5W wirewound
1 500Ω horizontal trimpot (VR7)

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	10MΩ	brown black blue brown	brown black black green brown
1	1MΩ	brown black green brown	brown black black yellow brown
3	470kΩ	yellow violet yellow brown	yellow violet black orange brown
5	100kΩ	brown black yellow brown	brown black black orange brown
1	47kΩ	yellow violet orange brown	yellow violet black red brown
1	39kΩ	orange white orange brown	orange white black red brown
2	22kΩ	red red orange brown	red red black red brown
2	18kΩ	brown grey orange brown	brown grey black red brown
4	15kΩ	brown green orange brown	brown green black red brown
21	10kΩ	brown black orange brown	brown black black red brown
4	4.7kΩ	yellow violet red brown	yellow violet black brown brown
7	2.2kΩ	red red red brown	red red black brown brown
11	1kΩ	brown black red brown	brown black black brown brown
3	470Ω	yellow violet brown brown	yellow violet black black brown
1	220Ω	red red brown brown	red red black black brown
5	150Ω	brown green brown brown	brown green black black brown
1	120Ω	brown red brown brown	brown red black black brown
2	2.2Ω	red red gold brown	red red black silver brown

Capacitor Codes

Value	IEC Code	EIA Code
330nF	330n	334
220nF	220n	224
100nF	100n	104
15nF	15n	153
1.5nF	1n5	152
680pF	680p	681
560pF	560p	561
390pF	390p	391
330pF	330p	331
220pF	220p	221
150pF	150p	151
39pF	39p	39
22pF	22p	22
10pF	10p	10

install the speaker in its rebated hole in the front panel. We used some self-adhesive foam tape underneath the speaker to make it an airtight seal.

Fit the speaker grille over the front of the speaker and screw in the four mounting screws. The grille may seem like overkill because the speaker cone is so far back from the front panel – but if you don't fit one it won't be long before you wished you did!

Testing

Before installing the assembly into the box, you can test the circuit by applying power using the battery.

At switch-on, the power LED should flash at a one-second rate. Check that there is power to the op amps by testing for 12V between pins 4 and 8 of the LM833, TL072 and LM358 op amps (IC1, IC2, IC4, IC5, IC6) and at pins 4 and 7 for the TL071 op amps (IC3, IC8). IC7 should have 12V between pins 1 and 8.

The output of IC4b (pin 7) should be at half supply, at around +6V. Similarly, the outputs of IC1a (pin 1), IC1b (pin 7), IC2a (pin 1), IC2b (pin 7), IC3 (pin 6), IC4a (pin 1), IC5a (pin 1), IC5b (pin 7) and IC8 (pin 6) should be also at about +6V.

Check that the circuit works by connecting the loudspeaker and applying an audio signal to one of the inputs. Turn up the volume and the speaker should begin to produce sound. The power LED should light continuously when not muted.

Check operation of the charger by connecting the output leads to the piggyback battery terminals (make sure the polarity is correct) and connecting the DIN socket to the AC input on the charger.

Switch on power to the plugpack and the charger LED should light and possibly the charging LED will light depending on battery charge.

Mount the charger board on the inside of the cabinet, making sure that the two LEDs align and protrude through their respective holes in the control panel.

Use 4G x 16mm screws to attach it in place. We used a small rubber grommet cut in half to lift the two front mountings of the PC board off the cleats by about 1mm.

The L-shaped amplifier bracket/panel is installed into the box by sliding it into the 2mm gap and securing it to the cleat frame with 4G x 16mm long screws. The battery leads for the amplifier and charger pass through from the rear of the battery compartment .

The battery cover is secured with three 6G x 30mm countersunk screws. With the dimensions shown, the battery should be a snug fit but if necessary, pack some pieces of foam into the compartment to stop it moving around in transit.

Finally, a chassis-mounting 3-pin mains socket, screwed to the inside bottom of the case (next to the battery compartment) but not connected to anything makes an ideal plug-pack holder when the plugpack is not being used to charge or power the PortaPAL.

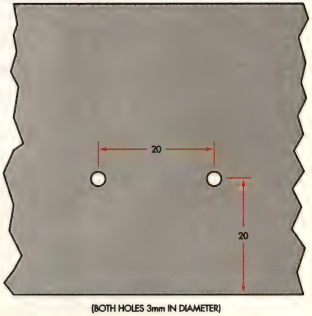


Fig.6: this template can be used to ensure your drill holes ion the heatsink are in exactly the right place!

MAKING THE BOX

One of the areas where home constructors come unstuck is in the cutting-out of speaker box panels. It is essential that the edges are not only straight and square but opposite panels also need to be exactly the same size – otherwise the box may be crooked or there may be air gaps.

For a typical part-time woodworker using typical home workshop tools (as distinct from a pro who does it all the time!), achieving perfectly straight, smooth and square cuts with a hand saw or any type of hand-held power saw is difficult. Yes, it can be done – but it is difficult.

However, there is a delightfully easy way to ensure that at least three sides of each panel have perfectly straight and parallel sides/right angles – and that is to use sheets of pre-cut board. (If the manufacturers can't get it straight and square then we are all in trouble!)

For this reason, we have elected to use two sheets of 16mm, 450 x 900mm craftwood (MDF would also be suitable). We have made the three vertical panels (ie front and both sides) 450mm high. Originally we had planned to use a single sheet of 900 x 900mm board but fortunately couldn't find any in our local hardware store. So we purchased two 450mm wide sheets and suddenly realised what an advantage that was!

Cut the two sides (240mm wide) from the top of each sheet and the front (247mm wide) from the bottom of one of the sheets (as shown on the cutting diagram) and you'll have three edges on each panel perfectly square. The fourth edge depends on how accurately you cut.

The identical top and bottom pieces (240 x 280mm) and the various bits and pieces which form the battery holder, etc, can be cut from what is left over.

The vertical panels sit between (ie, inside) the top and bottom pieces, making the overall height of the box 482mm (450+16+16). One reason for placing the vertical panels inside the top and bottom, rather than vice-versa, is for strength. As made, the box will easily handle someone using it as a seat (as will inevitably happen).

The front panel and the various rear pieces are recessed – the front back far enough to accommodate the speaker grille, while the rear is even further recessed. Recessing both front and back will allow the box to fall over and not break or damage the speaker itself, pot knobs or other controls.

It might appear that 247mm is wrong for the front panel: if the base is 280mm wide and the two sides are 16mm wide, surely it should be 248mm (280-16-16)? That extra 1mm off allows the front panel to be a snug, but not too tight fit.

We cut suitable lengths of 16 x16mm meranti (which we happened to have on hand – just about any softwood will be OK) for the cleats – all around the front inside of the box for the box front (speaker baffle) to attach to and in strategic locations on the rear inside as shown by our drawings.

Before assembling the box proper, we glued'n'screwed the cleats in position.

The "L"-shaped aluminium plate holding most of the amplifier electronics screws to these cleats.

After the cleats were done, the top, bottom and two side box panels were glued and clamped together, and allowed to dry overnight. The (unglued) front panel was placed in position as formwork to keep the whole thing square,

When dry, we pushed out the front panel and on it marked and cut (with a jigsaw) a 185mm circle right in the centre. Naturally enough, this is where the speaker mounts – but first, the hole needs a 7mm deep, 10mm rebate all around from the front (using a router) to allow the speaker to sit flush.

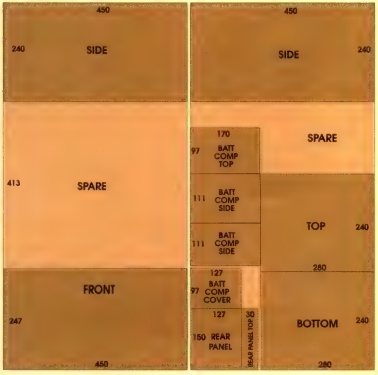
A 200mm metal speaker grille goes over the speaker later on to protect it.

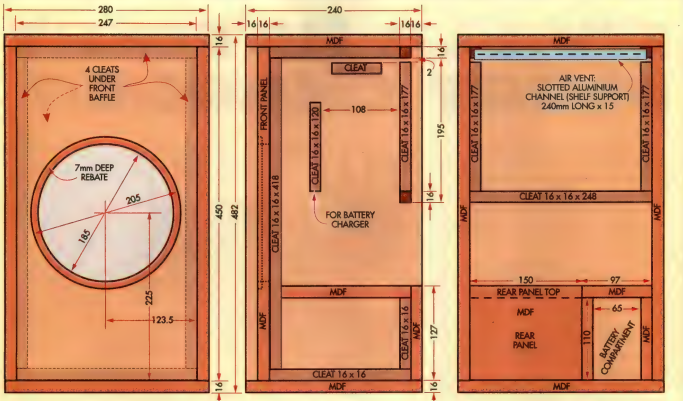
The final bit of woodwork is the mounting of the various bits of craftwood (or MDF) which hold the battery and other components in place. These mount as shown in our detailed drawing opposite.

The finished box, measuring 280(w) x 240(d) x 482(h), can be painted, veneered, or as we have done, covered in speaker "carpet". A lot of pro audio gear is covered in this stuff because it helps it absorb knocks and scrapes on the job or in transit. It also hides any "sins" you might have created along the way.

The carpet is glued on with contact adhesive, making sure it is stretched nice and tight over and around the box. Edges are trimmed with a sharp knife and also glued.

We also completely covered the inside of the box (and even the back of the speaker magnet) with the carpet to act as a sound deadening and resonance-reducing agent. It looks schmick, too! All these pieces need to be cut to the





appropriate size before glueing in place.

Eight plastic speaker box corners were fitted on all corners (top and bottom) to protect them from damage. For ease of transportation we added a flexible carry handle. As we mentioned before, a metal speaker grille is fitted over the front of the speaker cone to protect it.

In perhaps a bit of overkill, we added a "top hat" stand mount to the bottom of the box. This allows the box to be mounted "up high" on a standard 35mm speaker stand (or even a length of 35mm OD water pipe driven into the ground). Raising the box above the heads of an audience dramatically improves the sound "throw", allowing greater coverage without the use of a second box or extension.

Finally, the "aluminium air vent" shown above is simply an offcut from a length of U-shaped slotted aluminium channel used for shelf support verticals (the kind brackets clip into to hold shelves) which shoud be available at any hardware store. It even comes with the slots pre-cut for you!

These three shots, along with the diagram above, give a pretty good idea of how we constructed our box. Of course, other approaches may be just as valid – and because it *is* for PA (not hifi) use, dimensions are not particularly critical with the exception of the speaker cutout, battery compartment and, of course, the amplifier mounting arrangement.

12V SLA BATTERY FLOAT CHARGER

Some readers will be aware that we produced a 12V DC float charger in October 1998. Why not simply employ that circuit in the PortaPAL PA amplifier?

The answer is that we did try it in our first prototype but it was found to be unsuitable for this application, for the following reasons:

First, the October 1998 charger feeds pulses of rectified AC to the battery and while this is perfectly valid for battery charging, the resulting ripple across the battery and hum radiation from the battery leads was enough to be picked up by the sensitive microphone circuitry to become quite audible.

Plainly, this was a major drawback, especially as most users would want to use mains power where it was convenient and available.

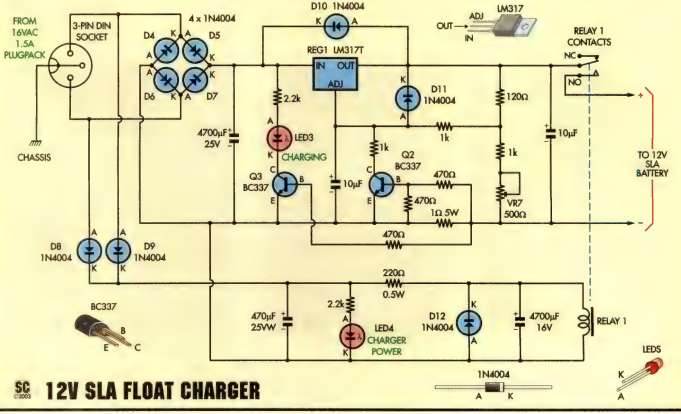
Second, once power is removed from the input to the charger, it pulls a significant current from the battery. This would totally discharge the battery if the PA system was not used for a few weeks.

Such an occurrence would destroy the battery. Not good.

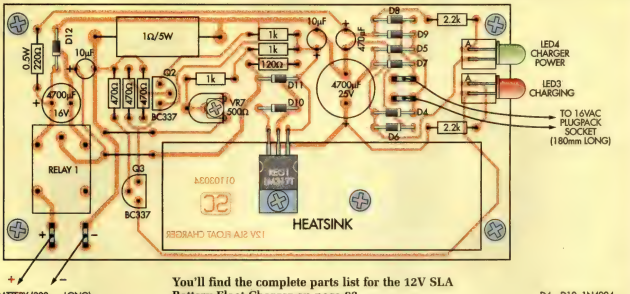
Hence, our new float battery charger feeds pure DC to the battery and is disconnected from the battery when the AC input is removed. With no input power and the PA amplifier also switched off, there is no current drain from the battery and it should have a shelf life of many months, if not years.

The charger circuit is shown below. As mentioned before, this also makes a perfect general-purpose 12V SLA battery float charger.

Power for the charger circuit comes from a 16V 1.5A AC plugpack which feeds diodes D4-D9 to produce two DC supplies. The main supply comes from diodes D4-D6 and the 4700µF capacitor. The capacitor is nec-



12V SLA FLOAT CHARGER



You'll find the complete parts list for the 12V SLA Battery Float Charger on page 62.

D4 – D10: 1N4004

essary to ensure that the battery is charged with DC that is free from ripple. Any ripple would be heard in the amplifier's output.

3-terminal regulator REG1 sets the maximum battery charge voltage to 13.8V. It operates as follows. The voltage between its output and adjust (ADJ) pin is fixed at 1.25V and this voltage is applied across the 120Ω resistor (neglecting the small current drawn by the ADJ pin). The resulting 10mA through the 120Ω resistor flows through the 1kΩ resistor and series 500Ω trimpot VR7 to provide a voltage across them, effectively jacking up the regulator voltage. Trimpot VR7 is adjusted for an output of 13.8V.

Current limiting

A 1Ω 5W wirewound resistor is used to monitor the charging current. The voltage developed across it is monitored by transistor Q2. When the voltage across the 1Ω resistor reaches 1V, corresponding to a charging current of 1A, the base voltage of Q2 reaches about 0.5V and it begins to conduct, pulling the ADJ pin of REG1 lower to reduce the output voltage of REG1. This limits the charging current to 1A.

Transistor Q3 also monitors the voltage across the 1Ω resistor. Q3 turns on whenever the resistor voltage is above about 0.5V to drive LED3, the charging indicator. So provided the charging current is more than about 500mA, LED3 will be alight.

Once the battery voltage reaches 13.8V, the charging current drops to zero and the battery is effectively "on float".

When power to the charger is switched off, the battery could be drained back via the resistors across REG1. To stop that, we added the relay circuit, to disconnect the battery from the charger if no mains power is present.

Diodes D8 & D9, in conjunction with diodes D4 & D6, produce a separate supply from the 16VAC plugpack. This is filtered with a 470µF capacitor and then fed through a 220Ω resistor so that the relay is driven with 12V. The 4700µF capacitor across the relay coil delays the relay switch-on until the 4700µF capacitor for REG1 is fully charged. Without this delay, the initial switch-on of the charger would cause a loud hum in the loudspeaker until the 4700µF capacitor for REG1 was fully charged.

LED4 provides power ON indication.

Charger board assembly

The 12V SLA float charger is assembled on a PC board measuring 133 x 66mm, coded 01103034. It has a single-sided heatsink for the regulator (REG1) measuring 84 x 24 x 28mm (Altronics H-0668 or equivalent). The component overlay is shown above.

Once you have checked the board for obvious defects such as open-circuit tracks, shorts and undrilled holes, install the small components such as diodes and resistors first. Watch the polarity of the diodes. Then install the two transistors, 500Ω trimpot, the electrolytic capacitors and the relay. Again, watch the polarity of the electrolytics.

When mounting the 1Ω 5W wirewound resistor, make sure there is about 1mm clearance between the resistor body and the PC board. This improves cooling for the resistor.

The two high brightness LEDs are mounted in right-angle PC mounts (Altronics H-1543 or equivalent). These enable the LEDs to mate precisely with the control panel of the amplifier.

The 3-terminal REG1 is mounted on the heatsink with its leads bent, inserted and soldered into the PC board holes. The heatsink and regulator tab are then secured to the PC board with two M3 x 10mm screws. Nuts and star washers are used on the underside of the PC board.

Four spade lugs are inserted and soldered into the PC board for the input and output connections. The positive spade lug output near the relay should be marked with red paint or nail polish, to ensure correct connection to the battery.

Testing

Before you can test the charger board, you will need to wire up the 16VAC plugpack which comes with bare 3-wire cable, one lead of which is intended to be earthed.

The cable is wired to a 3-pin DIN plug. The earth wire must go to the centre pin of the DIN plug while the other two wires go to the remaining pins. You will then need to temporarily wire up a DIN socket with the two AC wires going to pins 1 & 2 (not the centre pin) of the socket. These wires then should be fitted with spade connectors to fit the spade lug inputs on the charger board.

Switch on the plugpack and the charger LED should light and possibly the charging LED will light depending on battery charge.

Disconnect the battery and then set the trimpot for an output of 13.8V, using a digital multimeter. The charger is now ready to go. **SC**

By JULIAN EDGAR

Little Dynamite Subwoofer

Build your own compact subwoofer – ideal for use in a car or home unit

SUBWOOFERS ARE NOW almost universal in any car system that attempts to produce quality music. They're also prevalent in home theatre systems and also make a great upgrade for a compact sound system that needs a bit more punch. The subwoofer described here is dead-easy to make and gives excellent performance, considering its compact size and low cost.

And if you think that it's really a bit too limited in power handling and low-down frequency response, stay tuned – we've got another more complex, higher-power design coming soon. But honestly, unless you want to make a social statement to sidewalk pedestrians or your neighbours, this subwoofer will be more than adequate for most music!

The design

We'd been considering doing a subwoofer project for some time – and in fact went as far as designing a bandpass model using a 10-inch driver. However, by the time we'd priced the particle board and added in carpet, glue, terminals and a grille, the cost was around $130 for the enclosure alone. What's more, it would have taken quite some effort to build.

It was about this time that Jaycar Electronics released a range of subwoofer enclosures, all pre-built and

Main Features

- Small enclosure
- 125 watts power handling
- Excellent in-car response
- Competent in-room response
- Easy to build & low cost

finished with carpet and loudspeaker terminals. Their boxes start at just $59.50, so we made a radical change to our plans. The bandpass design was scrapped and we set about designing a traditional ported design instead.

A ported enclosure is one of the oldest box types around (see "Ports Enclosure Size & Other Design Considerations"). However, the design of this type of enclosure has been revolutionised in recent times with the development of loudspeaker design computer software. Rather than building a box and then laboriously testing it in many different configurations, computer software now allows the virtual construction of dozens of different enclosures.

In addition, good subwoofer design software (like the BassBox package that we used) makes various suggestions during the design process. However, if you want to aim for an optimal trade-off in terms of size, response, sensitivity and power handling, such a design process can still take many hours to complete.

The first step in the design can be either the selection of the driver or the enclosure. In our case, we did a bit of both. First, the enclosure – the new pre-built subwoofer boxes come in 25, 35 and 45-litre nominal interior volumes (we've written "nominal" for good reasons which we'll come back to later) and the hole for the driver is already cut. This means that if you want to use a 10-inch driver, then the 25-litre box is the only one to go for (the 35-litre box is precut for a 12-inch driver, while the 45-litre box is cut for a 15-inch driver).

The driver used in the Little Dynamite subwoofer is 10 inches (25.4cm) in diameter, is rated at 125W RMS and uses a voice coil 50mm in diameter. It costs $99 and is available from Jaycar.

Note that the boxes are available in both sealed and ported designs.

We leaned towards a 10-inch driver as in general terms they're cheaper than larger sizes and can usually be fitted into a smaller box, which again has a cost advantage.

Choosing the subwoofer

So with the 25-litre box the chosen

BassBox: Loudspeaker Design Software

The BassBox software package is available in two forms – BassBox Lite and the BassBox Pro professional version. The Lite version is quite sufficient for any speaker design work that most people will want to carry out and is the package that was used to design this subwoofer.

In addition to being able to model the performance of bass-reflex (ported) speaker enclosure designs, this software can also model sealed and passive radiator boxes and a range of bandpass designs. The Lite version comprises just a single CD and the Help and background explanations are all available on-screen. In fact, this information is very good indeed – with some study, there's enough information for even a beginner to start designing sophisticated speaker enclosures.

And if you have a background in audio, the flexibility and detail of the program will be even more useful.

BassBox Lite is available in Australia for $165 from ME Technologies at **www.me-au.com** and also from Harris Technologies at **http://www.ht-audio.com**

The port is formed from two flared speaker vents (available from Jaycar) joined by a length of 65mm-diameter plastic pipe.

The completed port – the two flared ends reduce turbulence so that there are no problems with port noise. Make sure that you don't glue the ends on at this stage, though – otherwise you'll never get the assembly into the box!

enclosure, which speaker would be suitable for it? Keeping it in the Jaycar family, we opted for the CS-2274, a 10-inch "titanium" finish driver with 125W RMS power handling, an X-max (maximum cone movement) of 9mm, a voice coil diameter of 50mm and a resonant frequency of 33Hz.

What these specs add up to is a competent driver that should be able to produce good bass in the right enclosure without breaking the bank (the driver retails for just $99). The only spec that isn't quite as good as we'd like is sensitivity – with a sound pressure level (SPL) of 88.2dB at 1 Watt 1 metre, it needs to have both an enclosure design which is efficient and a power amplifier with at least 100 watts RMS behind it.

The "step" in the inner surface of the port that would otherwise be formed between the flared ports and the plastic pipe is smoothed away using a half-round file and sandpaper.

Port size

While free speaker design software is available on the web, we've not seen any program that comes close to BassBox – so it makes sense to pay the necessary dollars if you want this kind of package. One area that we were very conscious of when software modelling the design was the behaviour of the air within the port. Typically, ports are made too small in diameter – it's easy that way because then they can be made shorter for the same box tuned frequency.

However, small ports give rise to high air velocities, which in turn causes port noise or "chuffing". BassBox can predict maximum port velocities and recommend minimum port diameters to eliminate this problem. However, after looking at the modelled behaviour of a system using the pre-built ported enclosures (the 25-litre box comes with one 50mm ID port), we decided to buy a sealed box and then cut a hole for a port of our own making.

So what does the final design look like? First, the Jaycar "25-litre" box is actually 23 litres – an important difference when it comes to the design. Second, the volume taken up by both the driver and the port need to be subtracted from the available internal volume (BassBox does both of these things automatically if the right data is entered). In addition, the effect of

Ports, Enclosure Size & Other Design Considerations

A speaker's role in life is to create sound waves and it does this by moving its cone back and forth in response to electrical signals. When it pushes forward, higher air pressure is created in front of the cone; conversely, when it moves back, lower air pressure is the result.

If a bare woofer is sat on the bench and driven by a bass signal, the pressure waves find their way around the edge of the frame and partially cancel each other out. A fundamental task of a loudspeaker enclosure is to prevent this wave cancellation and its adverse effect on bass response. A sealed enclosure, for example, dissipates the energy from the back of the cone into the box (and/or the box filling). However, because these pressure waves are being wasted, the efficiency of a sealed enclosure is not as high as for a ported enclosure.

In a ported enclosure, radiation from the back of the cone is used to reinforce the pressure waves being generated by the front of the cone. This is achieved by using a tuned-length port or vent, which has the effect of altering the phase of the waves emanating from the rear of the speaker. Put your hand near the port used in this type of design and you'll notice that as the woofer cone moves forward, so does the air in the port – the pressure waves from the back of the cone are now reinforcing those coming from the front.

However, if the port isn't just the right length and diameter, the response of the speaker can be all "wrong". For example, in this design, we used a port 63mm in diameter and 360mm long. But what if the port had been only 150mm long?

Fig.1: the red curve show the in-car response of the subwoofer using a 360mm-long port, while the yellow curve plots the predicted response if the port is reduced to just 150mm long.

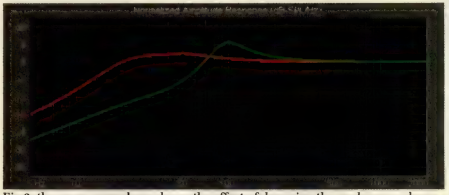


Fig.2: the green curve here shows the effect of dropping the enclosure volume to 12 litres and using a 75mm-diameter port that's just 100mm long.

Fig.1 shows the changed response – the red line is the in-car performance of the subwoofer as described in this article, while the yellow line shows the predicted response with the shorter port. As shown, with the shorter port, the bass falls away more quickly and is also "peakier". (Actually, the selected driver is quite tolerant of design changes – with some speakers, the results of such a port mismatch would be much worse!)

The speaker enclosure volume is also a vital part of the design. In the case of the response curve indicated by the green line in Fig.2, we've dropped the enclosure volume to 12 litres and used a short, fat port – 75mm in diameter and 100mm long. The resulting in-car response is very peaky at 100Hz.

As a result, this type of enclosure design that would give "one-note" bass, a problem often found in ported loudspeakers enclosures that are not well designed.

the acrylic speaker fill also needs to be taken into account (confusingly, the fill expands the volume that the driver sees).

In the end, we had 19.5 litres available and chose to use a port 63mm in diameter and 360mm long. This gives a box tuned frequency of 33Hz. Note that the tuned frequency in a ported design is often close to the speaker's resonant frequency (in this case, it is identical).

Modelled in a car environment, the response is effectively strong down to 15Hz, while in a room the -3dB point is at 38Hz. The modelled maximum port velocity is only 23 metres/second at 125W input power and 22Hz which – not coincidentally – are also the exact conditions where the cone reaches its maximum excursion.

To avoid any possibility of port noise in this long vent, both ends of the vent are flared. This is achieved by using two Jaycar CX-2688 flared speaker vents, joined with 65mm-diameter plastic pipe. The two vents slip tightly into the pipe, allowing the easy construction of a double-ended flared port.

Building It

If you have available an electric jigsaw, some hand tools and a tube of general purpose building adhesive (eg, water clean-up Liquid Nails), building the complete subwoofer will take

The hole for the port is marked on one side of the enclosure, towards the back of the woofer. This 85mm-diameter food tin was an ideal size for marking out the hole which was the cut out using a jigsaw.

you nearly no time at all – in fact an hour, tops!

The first step is to remove the sharp inside edge of the flared speaker vents; ie, at the end opposite the flare. This is done to eliminate any sharp steps between the flared vents and the plastic pipe when they are joined together. You can use a round or half-round file for this job, finishing off with some fine sandpaper.

If you don't have any sandpaper handy, a stainless steel kitchen scourer works quite well on the soft plastic.

With these edges smoothed, cut the plastic pipe to the right length so that when both flared ends are pushed firmly into it, the total port length is 360mm. Don't be tempted to glue both flared ports to the plastic pipe at this stage – you still need to fit the port into the enclosure!

Once the port has been assembled, spray some black paint inside it to cover any scratches that you have made and to hide the white plastic.

Drill a hole just inside the marked area for the port cutout to allow the insertion of the electric jigsaw blade.

Parts List

1 10-inch Response Subwoofer; Jaycar Cat. CS-2274
1 25-litre sealed subwoofer enclosure; Jaycar Cat. CS-2520
1 acrylic speaker damping material; Jaycar Cat. AX-3690
1 10-inch protective grille; Jaycar Cat.AX-3522
2 flared speaker ports; Jaycar Cat. CX-2688
1 500mm (approx.) length 65mm-dia. plastic pipe
1 short length heavy-duty speaker wire
1 tube building adhesive (eg, Liquid Nails)
8 speaker attachment screws

The next step is to cut the hole for it in the side of the speaker box. An 85mm hole is ideal – we drew the cutting line with the help of a can of food that conveniently had the right diameter. The port must be placed at the magnet end of the speaker to give sufficient clearance, with the hole cut in an end wall. Before marking the hole, consider the placement of the terminal strip and how you intend positioning the box in its final home, as these might have a bearing on where you want the port to be.

The hole should be cut so that the edge of the flare ends up about 20mm in from the edges of the box. This causes the other end of the port to sit with its flared outer edge against the inner walls of the box, allowing it to be further held in place with some dobs of adhesive. For environments where the subwoofer will be subjected to lots of shaking, use an additional internal fastening to hold the port tube in place – for example a bracket made from aluminium strip wrapped around the port and then attached to the inner panel of the box with short woodscrews.

The flared port can now be assembled within the box. If you push the ends on after you've applied a smear of adhesive to the pipe, they will be held in place firmly. The flared end that sits flush on the surface of the box needs to be thoroughly sealed from behind using Liquid Nails or a sili-

cone sealant. Make sure that you give the sealant time to set!

Next, the acrylic speaker damping material can be cut to size and stuck to the inner walls of the box. We suggest 350 grams/square metre material (Jaycar AX-3690) but any similar material is fine – eg, acrylic quilt wadding. Be careful that you don't block the port – in fact it is wise to be quite sparing in your use of the material around the port entrance.

Next solder some heavy duty speaker cable to the box terminals and attach the other ends to the screw terminals on the loudspeaker. Make sure that the positive terminal on the box is connected to the positive terminal of the loudspeaker and similarly for the negative terminals! The woofer can then be slipped into its precut hole and the positions marked for its mounting screws.

That done, remove the speaker and drill small diameter pilot holes for the screws. Clean away any shavings, then reinstall the driver and fasten it into place using eight coarse-thread MDF screws. Here's an important note: the carpet will compress as you tighten the screws, so go right around the speaker at least three times, tightening them each time.

You'll note that we've left off the protective grille at this stage. Instead, it's time to do some testing.

Testing

The first step is easy – apply a 1.5V battery across the terminals and make sure that when the positive and negative battery terminals are applied to the positive and negative subwoofer terminals respectively, the woofer cone moves forward. If it moves backwards, open up the enclosure and swap the wiring connections at the speaker!

The next step is to connect the subwoofer to an amplifier. Begin by driving the unit quite gently. Moisten a finger and move it around the edge of the driver, to check for any air leaks past the frame. Now do the same around the edge of the port – there will be air movement within the port itself but there shouldn't be any around the edge of the flare.

Next, listen carefully for buzzes, rattles and whistles. During the prototype's development, we had a buzz that we chased and chased and chased. It turned out that there were two reasons for this buzz. First, at high output levels, the interior of the car was getting excited – ie, bits of trim inside the car were resonating. And second, we were driving the 150 watts/channel amplifier so hard that it was going into distortion.

A jigsaw will make quick work of the port hole. The rim of the flared port covers the edge of the hole so don't worry if you don't cut a perfect circle.

The latter is pretty important to avoid – while this is a rugged speaker with cone movement well controlled down to about 22Hz, start pumping up the SPL and you might find that you're working the amplifier harder than you thought. And remember: more speakers get destroyed by pushing the amplifier into distortion than ever get damaged by exceeding the speaker's limits!

If everything seems fine at low volume, wind up the wick a bit more. Naturally, during this test procedure, you should disconnect all the other speakers, so that you're just listening to the subwoofer. It won't sound won-

The flared speaker port inserted through the hole. The striped background is the rug on which the box is sitting while the work is being done – unlike an untrimmed box, this one needs to have its finish protected during the build process.

This is the inside view – the plastic pipe is slid over the external flared port after which the second flared port is added at the other end.

Acrylic filling is glued to the walls of the enclosure, making sure that the port entrance remains clear. The port is held in place by sealant/glue applied at each end. If the subwoofer is going to be subjected to lots of movement, add an extra bracket to secure the port tube in place.

derful (no subwoofer does on its own) but it will allow you to easily identify any problems.

As stated earlier, because of its relatively low sensitivity, this subwoofer isn't going to deliver ear-splitting SPLs from modest amplifiers. However, if you have 100-125W available, it should be capable of delivering lots of low-end bass.

If all is well, you can now reconnect the other speakers and then balance the system for the bass response that you want.

Finishing

The final step is to attach the protective speaker grille. To do this, you'll have to take the driver out again so that you can place the "T" nuts on the back of the baffle. While the speaker is out, check that the port is still rigidly held in place by its glue and/or brackets and that none of the acrylic speaker filling has moved around. You should especially check that the port entrance has remained clear.

It's then just a matter of completing the assembly and enjoying the fruits of your labours! **SC**

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PICAXE-08 CHIPS... See Silicon Chip FEB 03
The PICAXE processors use a R.I.S.C. (Reduced Instruction Set Controller) system, and are easy to program. It is said to be like a Basic Stamp clone in single chip. $5.50ea. Lots of Info available on the Internet. We may have other PICAXE chips in the future.

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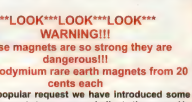

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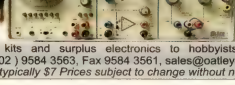

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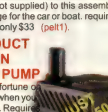

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SC_MAR_03

Canon's image stabilised binoculars

Whether you like to watch whales, birds or sport, a pair of binoculars is a great accessory. However, they do have disadvantages. Most binoculars are not light and the longer you use them, the more tired you become.

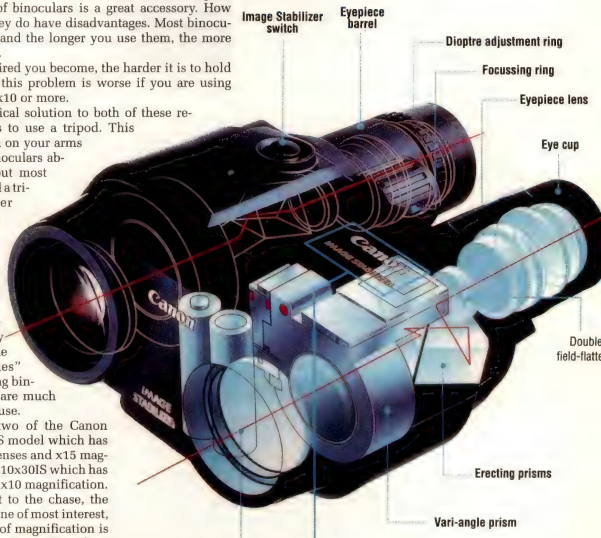
And the more tired you become, the harder it is to hold them steady and this problem is worse if you are using magnification of x10 or more.

The only practical solution to both of these related problems is to use a tripod. This relieves the strain on your arms and holds the binoculars absolutely steady but most people would find a tripod just another piece of gear that they don't want to carry.

Canon's solution to the problem is to produce binoculars with inbuilt image stabilisation. They compensate for the inevitable "shakes" you get when using binoculars and they are much more pleasant to use.

We reviewed two of the Canon range: the 15x50IS model which has 50mm objective lenses and x15 magnification and the 10x30IS which has 30mm lenses and x10 magnification.

Cutting straight to the chase, the x15 model is the one of most interest, since that degree of magnification is almost impossible to use without having a tripod. In fact, unless you are experienced in using binoculars, it is difficult to imagine how difficult such a seemingly modest degree of magnification is.



This cutaway diagram shows the disposition of the major components in the Canon image stabilised binoculars. Note the compact Porro prisms which erect the inverted image for normal viewing.

The Canon 10x30IS binoculars (above) are much more compact and half the weight of the higher power 15x50IS model (left) but use the same image stabilisation system.

In effect, even if you are pretty steady on your feet, and you brace yourself against a wall, table or whatever, you will find the object you are looking at shakes around so much that you quickly get frustrated with the attempt – it is that hard.

But switch on the Image Stabilisation and all of a sudden the images snap into a rock steady condition and you can view in much more comfort. You can pan around and even view from a boat or moving car. In short, Image Stabilisation makes viewing at x15 magnification entirely practical and satisfying.

It is even more effective on the smaller x10 binoculars and their much lighter mass means that you can view for much longer before arm fatigue gets you.

So how do they work?

Broadly speaking, there are two methods of image stabilisation. The first is widely used in camcorders and involves using only part of the image produced by the CCD sensor. In effect, the internal computer looks for the steady part of the image from the sensor and continually "edits out" the shaking borders, leaving a much steadier central image to be displayed as the video output.

The second method, used in these Canon binoculars and in some high-priced telephoto lenses, is to stabilise the image itself by passing it through a prism which can be continually moved to compensate for the shaking of the binoculars themselves.

Canon uses what they call a "vari-angle prism" which consists of two pieces of flat glass connected by flexible bellows which can expand and contract as required. The bellows are filled with a silicone-based oil which has a high refractive index (presumably the same as that of the glass plates). One glass is driven to compensate for pitch movement while the other is driven to compensate for yaw movement.

The drive system is a yoke (coil) and magnet system for both X and Y axes with Hall Effect sensors for feedback while the movement sensing is done by accelerometers.

While there is a separate vari-angle prism for the left and right eye optical paths, both prisms are linked together and driven by the X and Y axes yoke/magnet systems.

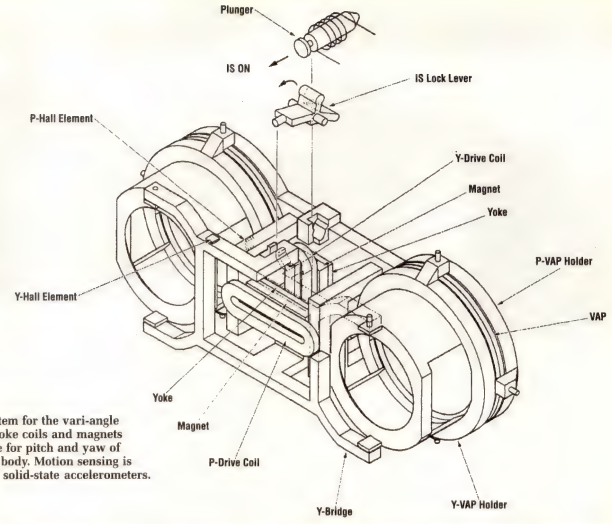
We include a cut-away diagram showing the major internal features of the Canon binoculars. Notice that they do include Porro prisms to erect the image but the overall shape of the Canons might suggest that they are using the more compact roof prism construction. Another diagram shows more detail of the image stabilising mechanism, including the yoke and magnet drive systems.

By way of explanation, all binoculars (except opera glasses) require prisms to erect the inverted virtual image for normal viewing. Most conventional binoculars use Porro prisms which give a Z-path to the light beams – this accounts for the big offset between the objective lenses and the eyepieces. In binoculars with roof prisms, the light travels in a straight line and therefore they are generally more compact.

The Canon Image Stabilisation are obvi-

Specifications

	15 x 50	10 x 30
Magnification	15	10
Objective lens diameter	50mm	30mm
Real field of view	4.5°	6°
Field of view at 1000m	79m	105m
Focus range	6m to infinity	4m-infinity
Exit pupil diameter	3.3mm	3mm
Eye relief	15mm	14.5mm
Dimensions	152 x 193 x 81mm	127 x 150 x 70mm
Weight (excl batteries)	1200g	630g
Battery life (alkaline)	2.5 hours	4 hours



The drive system for the vari-angle prisms uses yoke coils and magnets to compensate for pitch and yaw of the binocular body. Motion sensing is performed by solid-state accelerometers.

ously using a different arrangement of Porro prisms because the two objective lenses are solidly fixed within the binocular body while the two eye-pieces can be rotated to change the inter-ocular distance. The result is that the Canons are quite a bit more compact than conventional roof prism binoculars.

Another interesting feature is the inclusion of a doublet field flattener in the eye-piece lenses. This reduces the curvature of the field and avoids the usual distortion at the periphery of the image. It also gives long "eye relief" which means that people with glasses can comfortably use the binoculars.

The Canon 15x50IS binoculars are powered by two AA cells which last for up to 2.5 hours continuous use for alkalines or Nicad cells (at 25°C). If you use lithium batteries, this can be extended out to 8 hours continuous use. Alkaline battery life for the smaller 10x30IS model is 4 hours.

Using them

Referring to the Canon 15x50IS model first, they are comfortable to hold and easy to focus. However, people with small hands will find them difficult to grasp, even though they do have a non-slip rubber skin. And at over 1kg, most users will find that they are tiring to use for more than a few minutes at a time. They do have a tripod socket, so a monopod would be very worthwhile if you need to use them for extended periods.

Since I am interested in astronomy, I was keen to check how they would perform when viewing planets and stars. Unless you have a tripod/chair setup, the common way to use binoculars when viewing the sky is to lie down on the ground or on a reclining chair. But even this method can be very tiring and the star images tend to dance about all over the place after a few minutes.

With the Canon 15x50IS, it is a much more satisfying experience. Stars and planets can be held steady and you can easily achieve optimum focus. There is some flare and signs of chromatic aberration on star images but generally this is at a low level; after all, they are not really intended for astronomical use.

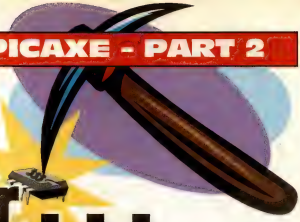
By contrast with the Canon 15x50IS, the 10x30IS are much more comfortable to grasp and hold, due to their much smaller size and weight (630g). However, with a magnification of x10 and good optics, they are very usable and compare very well with conventional 10x50 binoculars. We like them a lot.

Pricing

This is great technology but there is no getting away from the fact that these Canon Image Stabilisation binoculars are expensive. The recommended retail price for the 15x50IS model is $2499 including GST while the 10x30IS sells for $1249 including GST.

For further information, contact Canon at 1800 816 001 or **www.canon.com.au** SC

A Shop Door Minder . . . with attitude!



by Stan Swan

Last month (Feb 2003) we introduced the innovative PICAXE-08 IC and a simple application, a flashing LED, all built into a solderless "PICNIK box".

If you didn't see last month's issue, it will pay you to get a copy and read it because some of the concepts might be a little different to what you're used to, such as BASIC Stamps, etc.

By now, readers should have familiarised themselves with basic operations and the commands **high**, **low**, **pause** and **goto.**

PICAXE instructions are much the same as used in classic BASIC programming. There are a lot of BASIC texts around (no pun intended!), such as Greg Perry's "QBASIC by Example" (QUE 1993) or from the Parallax BASIC Stamp Programming Manuals. There's also a huge amount of information available on the 'net.

Given that you don't need to be a programming guru to use PICAXE instructions, initial applications here will be educational rather than exotic.

PICAXEs have only enough RAM for about 40 program lines, so there's some incentive to code efficiently! Our simple application here uses about half the memory available, so room remains for your own tweaking.

Shop Door Minder

A shop door minder usually consists of a light source which creates a beam, a light sensor which detects that beam and a buzzer circuit which sounds when the beam is broken. Sometimes there is a delay circuit to make the buzzer sound long enough to be noticed; sometimes the buzzer "locks on" when it is actuated to behave more like an alarm.

This month's circuit acts as a "shop door minder with attitude", since it not only sounds a buzzer when the light beam is broken but also provides a simple "traffic" indication by flashing a LED at an increasingly faster rate with each event.

Now *that* could be handy – if you don't happen to own a shop and wish to count customers, this project could, at a glance, tell you the number of times your cat door is opened! Don't own a cat? You'll think of something to count!

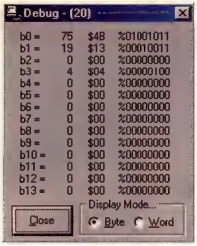
The flash rate increases are not linear but counts per minute can be noted and related to visitor numbers via a simple lookup table. A further LED could even be added (pin 0?) to indicate a count of 10 had been reached, at which point the main counter could drop back to a slow rate again. By this means, up to perhaps 30 events can be quite reliably "read off ".

If a PC remains attached, the exact count (to 255 events) can be just read off using **debug**. Mmm – 255 cats visited last night ? What IS in your pantry!

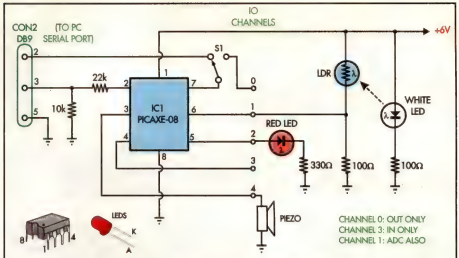
The circuit

Aside from the core parts mentioned last month, just a few extra resistors

If you don't happen to own a shop, you can always find something else to count – just remember to take into account four legs and a tail . . .



A "debug" screen shot. This reveals just how useful such PC feedback is – you can note all the variables ticking away nicely!



PICAXE ADC CIRCUIT (DOOR MINDER)

If this looks somewhat similar to last month's project, it just might be! The basic differences are the LED and LDR which provide an "analog" input to the PICAXE. The PICAXE programming does the rest.

are used, one of which is a light dependent resistor, or LDR.

Your setup values may vary depending on your application but 100Ω in the voltage divider, plus similar as a LED dropping resistor, should do.

For initial trials a small bright light (perhaps a white LED) is also needed. More practical setups could see the light path extended with lenses, shrouds or even a mirror. Only small currents pass along the wires so leads to the LDR and light can be conveniently placed. Things really depend on the stray background light seen by the LDR, although this can be allowed for to some extent by altering **readadc** threshold values.

For a longer light path the lens from a pocket torch may help to concentrate the beam, while the LDR could even be recessed into the torch base to give shading from stray light. The program's **readadc** threshold value, initially 160, may need lowering to suit of course.

To prevent false triggering from shadows, reflections or visitor legs (or tails!), a small delay, perhaps "**pause 500**", may be needed in the **readadc** loop. Obviously this delay may cause the unit to become unresponsive if events occur too rapidly.

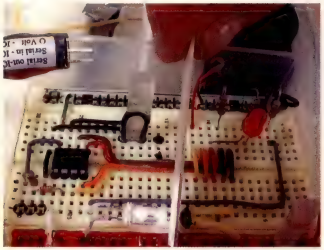
Having a light on to hold the alarm off may be wasteful of battery power of course. Perhaps you could modify the program so that darkness holds the sensor off and room light alone is enough to trigger things – much as would occur when a medicine cupboard door was opened.

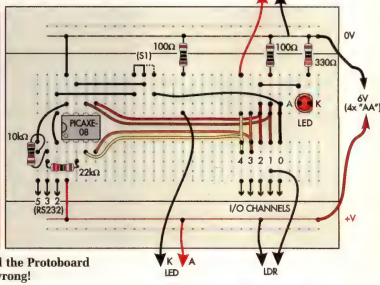
The point of these PICAXE circuits is to stimulate your interest, to see what can be done very cheaply and to help you come up with your own variations. Of course, we will help you along the way with more applications to keep those creative juices flowing!

Incidentally, if you come up with a scathingly brilliant PICAXE application that you would like to share with the world (and perhaps feature on these pages), please feel free to email me – **s.l.swan@massey.ac.nz**

Where to get the PICAXE-08

Currently there is no Australian distributor. Order direct from the UK agents (Revolution Education) on line shop **www.techsupplies.co.uk** – they are very prompt.





There are a few differences between the photo above and the Protoboard layout at right. Follow the layout and you shouldn't go wrong!

PICAXE-08 COMMANDS USED THIS MONTH

readadc

PICAXEs have a valuable Analog to Digital Conversion (ADC) feature, which in theory converts "real world" analog voltages into 256 steps of digital equivalents. There's an unavoidable deadspot on the upper range however and the resulting 160 divisions are treated in blocks of 10, so only 16 discrete values are available! Although obviously unsuitable for MP3 encoding or the like, this is quite enough for many simple applications.

In fact our circuit here uses ADC at just a yes/no level in response to an LDR's (light dependent resistor) resistance changes with illumination, so not even all these 16 divisions matter. Pin 1 ADC input needs a voltage rather than a resistance, so the old voltage divider trick is rustled up, involving two series resistors connected between +ve and ground with their midpoint delivering a variable voltage as the LDR value changes. The **readadc** command finally assigns this ADC value to a program variable at pin 1. Alter the **readadc** threshold value or resistor (here 160Ω and 100Ω) to fine tune with your LDR and light path.

Incidentally, LDRs typically have a resistance of 1 MΩ + in the dark and around 1 kΩ in bright light, with a quite rapid response as illumination alters.

sound

With the suggested piezo speaker, sounds can be directly produced from output pins using the sound command. Most piezos are optimised for high frequencies (typically 4kHz) so fidelity may be poor for other tones. It's worth experimenting with your setup, since a more distinctive "fruity" alert may be produced with two sounds together.

debug

If the serial programming cable remains connected during PICAXE runs, program data values can be usefully monitored on the PC screen. Up to 16 "byte" variables (b0 - b15) can have tabs kept on them.

pulseout

This provides timed duration output pulses (to microseconds) at specified pins, and effectively packages up HIGH, PAUSE and LOW in one efficient command .

for - next (step)

Creates a repeating loop that executes program lines between the FOR and NEXT statements as it increments. The optional STEP value defaults to 1 unless specified.

maths operations

Variables to a maximum value of 255 (at which point they roll over) can be added, subtracted, multiplied or divided, with left to right solving but with only integer solutions. Hex and binary are also handled but brackets are disallowed and fractional portions of results are discarded (although clever techniques can off set this).

BASIC PROGRAM LISTING (This can also be downloaded from http://picaxe.orcon.net.nz/adcprog.bas)

```
' Demo program for March 2003 SilChip PICAXE-08 article Ver1.0 20th Jan 2003
' Best assembled & tested with solderless "PICNIK" box as detailed SilChip Feb03
' Refer http://picaxe.orcon.net.nz for background info & potential of PICAXE-08
' Extra parts = LDR, White LED, Red LED, 2 x 100 Ohm, 1 x 330 Ohm, piezo speaker
' LDR & illuminating light can be moved apart- maybe use lenses & light guides?
' New commands here = sound, readadc, debug, pulsout, for-next & simple maths.
' Ref.PICAXE prog.editor .pdf help files,& BASIC Stamp manuals etc for insights
'      via Stan SWAN (MU@W, New Zealand)  => s.t.swan@massey.ac.nz <=
'-------------------------------------------------------------------------------
' Byte variables        b0= LDR "resistance value"    b1= event counter
'                       b2= pulse delay  in msec      b3= sound loop
' Strictly only the LHS code below is needed. Remarks (') can be ignored
'-------------------------------------------------------------------------------
sound 4,(100,10,80,10)          'initial dual sounds to inform that powered up

ldrdemo:                        ' LDR resistance monitoring routine
 readadc 1,b0                   ' read LDR low resolution value via voltage divider
 debug b0                       ' show variable LDR value(s) to attached PC screen
  if b0 <160 then beeper        ' warbling alert tones when LDR shaded
   b2 = 250/b1                  ' produce delay value.NB max variable value is 255
   if b2 =0 then ldrdemo        ' prevents LED flash when not yet triggered
 pulsout 2,1000                 ' pulse LED pin 2 for 1000x10 microsec =10millisec
 pause b2:pause b2:pause b2     ' more events give decreasing delay between pulses
goto ldrdemo                    ' continually loop unless LDR shaded

beeper:                         ' piezo speaker 2 tone sound routine
 for b3= 1 to 3                 ' loop to sound tones 3 times
  sound 4,(100,20,80,20)        ' repeating dual tones each 20 msec
 next b3                        ' sound loop increment
 b1=b1+1                        ' event counter increment
goto ldrdemo                    ' return to monitoring routine
```

Some more references . . .

1. "**QBASIC by Example**" Greg M Perry (Que Books 1993)
2. Parallax Inc, the BASIC Stamp originators, have free resource downloads (.PDF files) via their web site (**www.parallax.com**)

BASIC Stamp Users Programming Manual Version 2. (351 pages, 3.2MB download)

BASIC Stamp 1 Application Notes Ver 1.9 (126 pages, 1MB download).

3. "**The Art of Electronics**" Horowitz and Hill (Cambridge University Press 1989). Chapter 9 offers good ADC insights.

NEXT MONTH:

The Picaxe by now you should know,
Gives sounds & makes LEDs glow.
But it also does more,
Next 'tis a PWM chore,
And all for very small dough!

SC

SuperCharger Addendum

Did you build the SuperCharger described in the November & December 2002 issues of SILICON CHIP? If so, you need this add-on to ensure correct operation under all conditions.

By PETER SMITH

During finalisation of the firmware for this project, we were surprised to discover that under certain conditions, the 111kHz PWM section of the circuit became unstable. In fact, with high cell counts, high charge currents and low input voltages, such as could be the case in an automotive environment, the switching frequency halved to about 50kHz.

When low cell counts (1-2 cells) and low charge currents are combined, a lower operating frequency is of no consequence. However, at high power levels, it will cause inductor L1 to overheat and damage the PC board and surrounding components. It may also eventually cause MOSFET Q2 to fail.

Quite frankly, this problem initially had us stumped. The data sheets for the LTC1325 suggest that our design operates within specifications. In addition, the LTC1325 has no provision for external compensation, which is often employed in switchmode circuits to maintain loop stability.

After much head scratching, we devised a simple little circuit that modifies the feedback signal applied to pin 11 of the LTC1325. The purpose of the circuit is to both provide ramp compensation as well as to alter the shape of the waveform applied to this pin, so ensuring that the internal integrator is "reset" every cycle.

As this project includes a number of surface-mounted components, it would be very difficult for readers that have already built the project to transfer these to another, modified PC board. Therefore, rather than modifying the main PC board layout, we have designed a small "add-on" board that carries the necessary components.

Construction & checking

The add-on PC board simply attaches to one of the existing corner mounting points (see Fig.4) and connects to the main PC board via four wires. The overlay diagram for the add-on board is shown in Fig.2 and the wiring diagram in Fig.3.

SuperCharger Add-on Parts List

1 PC board coded 14111024, 31.2mm x 16.1mm
2 2N3904 transistors (Q1, Q2)

Capacitors
1 1μF 50V monolithic ceramic (C1)
1 100nF (0.1μF) 63V MKT polyester (C3)
1 1nF (.001μF) 63V MKT polyester (C2)

Resistors (0.25W 1%)
1 15kΩ (R3)
1 10kΩ (R2)
1 470Ω (R4)
1 100Ω (R5)
1 10Ω (R1)

Miscellaneous
1 M3 x 10mm tapped spacer
1 M3 x 16mm pan head screw
70mm 4-way ribbon cable

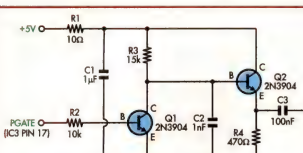


Fig.1: the add-on circuit uses just two transistors plus a few resistors and capacitors. Its job is to modify the sense signal to the LTC1325 IC.

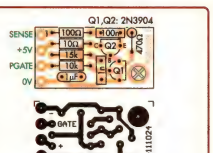
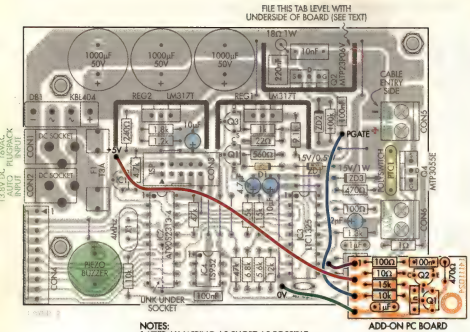


Fig.2: the extra parts all fit on this small PC board.


FILE THIS TAB LEVEL WITH
UNDERSIDE OF BOARD (SEE TEXT)
180 1W
1000µF 50V
1000µF 50V
1000µF 50V
10nF
CABLE ENTRY SIDE
DB1
KBL404
REG2
LM317T
REG1
LM317T
CON5
CON4
CON3
CON2
CON1
DC SOCKET
DC SOCKET
DC SOCKET
DC SOCKET
PGATE
Q1
Q2
Q3
Q4
MTP3055E
1.5V/0.5A
15V/1W
ZD1
ZD2
ZD3
ZD4
ZD5
ZD6
ZD7
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ZD39
ZD40

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Antennas & earthing systems for crystal sets

Crystal sets and other low-sensitivity receivers require good aerial and earth systems to give their best performance. Here's what you can do to improve broadcast band AM radio reception on these simple receivers.

Due to the improved sensitivity of receivers after the mid-1930s and the increasing power of AM broadcast transmitters, large antennas quickly become redundant as far as the general public was concerned. In fact, most people now don't like having to extend the whip antenna on a portable FM receiver to get the best reception.

Unfortunately, the use of metallic/bituminous insulation paper in the walls of many modern homes now acts as an RF shield, reducing the level of the radio signal penetration. For this reason, good reception on older, less-sensitive receivers may require an outside antenna and this is particularly so for crystal sets.

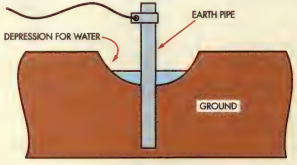
In the November 1998, December 1998 and January 1999 issues, we looked at various methods for improving AM radio reception and reducing interference. This article is not intended to supersede those articles but to give enthusiasts a few ideas on suitable antenna systems that will achieve good results in most situations.

The early days

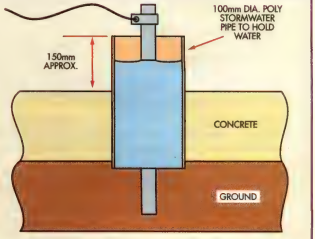
Experimental broadcasting commenced not long after the end of World War I. Amateurs produced programs on a nightly or weekly basis and the general populace was keen to listen to these new transmissions.

The output power of these early experimental stations varied considerably but most were well under 100 watts. The radiating systems connected to the transmitters were also quite varied, some consisting simply of an inverted "L" receiving type antenna fed against an earth that consisted of a metre or so of pipe driven into damp soil. Others were more ostentatious, being something like the smaller broadcasting masts that can be seen around the countryside today.

Official broadcasting commenced in Australia in late 1923 (2SB/2BL) and the power of the stations varied from around 50W to 5kW (5000 watts). In most cases, the power ratings were for input power, not output power, so a 5kW transmitter may have had an output power of just 1.5kW.



EARTH WITH WATER 'BOWL' TO KEEP IT MOIST



EARTH THROUGH CONCRETE

Fig.1: the earth stake or pipe should be driven a metre or so into the ground, with a small depression around the top. This depression is filled with water at regular intervals, to keep the soil around the earth stake moist. Fig.2 (right) shows how to install an effective earth through concrete.

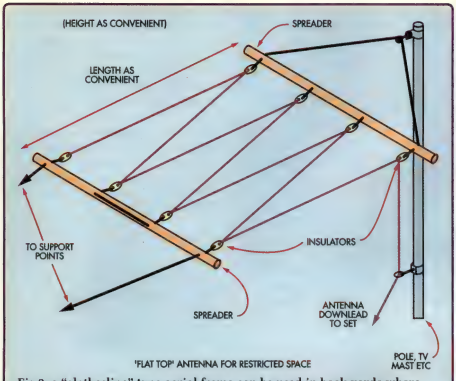


Fig.3: a "clothesline" type aerial frame can be used in back yards where space is a problem. It's not as effective as a long, straight run of wire but is still quite good.

Gradually the standards for broadcast transmitting stations became more uniform. The commercial class B stations that came into being were rated at an output of 2kW in the country and 5kW watts in the city, whilst Class A (ABC) stations used upwards of 10kW (today, the ABC stations run upwards of 50kW in many instances.) At the same time, strategically placed low-power stations (50-500W) were used to provide signals in areas where the high power stations were relatively ineffective (such stations are still used today).

Because of the low power of early transmitting stations and the general insensitivity of receivers up until the mid-1930s, large outside antennas were mandatory for reasonable reception during that period. Many different antenna types were used in an attempt to get the best performance possible. Some were a lot of work to install but may not have worked any better than much simpler structures. But they did look commanding!

A receiver using a large earth (mat) system (much like transmitting installations use) will work a little better than a receiver using the common, relatively inefficient receiver earths. In practice, transmitting stations go for the most efficient antenna and earth system that is economically feasible. That's because they need to provide the strongest signal possible for receivers that are using inefficient antenna systems, eg, a few metres of wire.

The reasoning here is that it is better to have efficient transmitting installations so that receivers can get by with convenient low-cost antenna systems.

Having said that, it is still necessary to use a relatively efficient antenna and earth system for low sensitivity receivers such as crystal sets.

The earth lead can be attached to the pipe using a metal hose clamp. Wrap the wire around the clamp several times to ensure it makes good contact.

"Egg" insulators will be required at the support points if you use bare wire for the antenna. Alternatively, you can use polyproylene pipe.

Getting a good earth

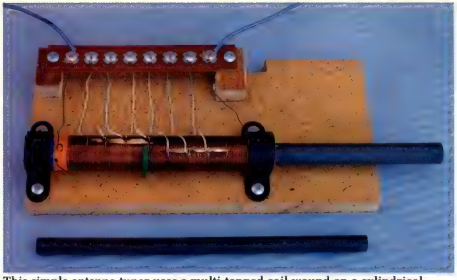
In an ideal situation, a 1-metre length of pipe or metal stake driven into the ground in a damp location will provide an adequate earth for most receivers. This earth should be as close as practical to the receiver so that the minimum length of connecting wire is used back to the earth terminal of the receiver. This also helps to reduce the effect of mains-borne interference, particularly in more sensitive receivers.

In my case, I have often used 19mm galvanised water pipes as the earth stake. However, because I am an amateur radio operator, I need a better earth than a 1-metre length of pipe can provide. For this reason, I commonly use up to three 2-metre lengths of pipe driven into the ground, leaving about 300mm above ground level. The tops of the pipes/stakes are quite close and are bonded together but their bottom ends are quite some distance apart, as the pipes are driven into the ground at angles to each other.

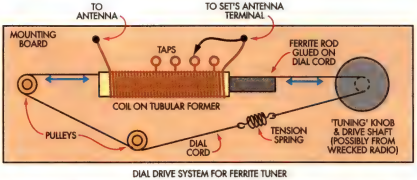
In order for the earth to be effective, the whole length of the pipe/stake and the earth around it needs to be kept moist (not just the top few centimetres of the soil). This is achieved by making a small depression around the top of the pipe(s) and a bucket of water then poured into this depression at regular intervals.

A single pipe driven at least a metre into the ground is usually quite adequate as an earth for radio receivers (providing it is in moist ground). Fig.1 shows the details.

The wire (preferably multi-strand)



This simple antenna tuner uses a multi-tapped coil wound on a cylindrical former. It's tuned by sliding the ferrite rod inside the former and by changing the coil tapping.



DIAL DRIVE SYSTEM FOR FERRITE TUNER

Fig.4: this diagram shows how to add a dial drive system to the antenna tuner shown in the photo at the top of this page. You can scrounge the parts from a junk radio or buy them from an electronics retailer.

going from the earth to the receiver earth terminal should be 1-2.5mm2 in cross-sectional area (equivalent to the average earth wire on the mains). It doesn't have to be insulated but insulated wire is easier to handle if it is likely to be close to any other metal, including the Sisalation type material used in the walls of modern homes. Don't let a bare wire brush up against any metallic object as noise and "crackles" (interference) may be induced into the wire and thus into the receiver.

Unfortunately, it's not practical to solder the end of the wire directly to the earth stake or pipe. That's because the metal mass is too great to allow it to get to the melting point of solder when using a soldering iron that's suitable for electronic work.

Instead, an electrician's earth clamp or a screw type hose clamp can be used to hold the earth wire firmly against the pipe. The wire should be wrapped through the clamp a few times to make sure it will not move once clamped. Before doing this though, clean the pipe using sandpaper to get rid of any oxidation at the contact point. Once the earth wire has been clamped to the pipe, the assembly should be painted to stop any corrosion.

Alternative methods

Not everyone has an ideal location to install earth stakes and so other methods of obtaining an earth must be used. For example, many premises today have large areas of concrete which this can make things quite difficult.

Drilling a hole through the concrete to accept an earth pipe is one possibility but make sure that you check the locations of water, drainage, gas, telephone and electrical lines before doing this. You will need a large masonry bit and a hammer drill for the job.

Begin by drilling a series of holes around the circumference of a circle large enough to accept a 100mm-diameter plastic stormpipe. A cold chisel and heavy hammer will be required to break up the pieces but even so, it usually isn't easy getting the pieces out.

In fact, it's probably a good idea to send the family out for the day so that they don't learn any new words!

The storm piping should protrude about 200mm above the ground and can be fixed into position using cement or silicone sealant. This stormpipe is then filled with water to keep the earth pipe moist - see Fig.2.

If metal water pipes are used, it's possible to clamp the earth wire onto these and obtain quite good earthing. However, earthing to a water pipe does raise the possibility of circulating currents through the pipe system and anything connected to the mains earth.

To overcome any chance of electrolysis (which can cause corrosion of the pipes), it's a good idea to install a capacitor in series with the earth wire near the radio. This can range in value from .001µF up to 0.1µF - preferably one of each in parallel. Note that this is necessary only if the receiver is mains operated and has its chassis earthed through the mains.

Gas pipes are not to be used under any circumstances.

For people in units, an earth via the mains may be the only viable alternative. Any piece of electrical equipment that has a 3-core power lead and has its metal frame earthed can be used as the "earth". All you have to do is attach a wire from the metal frame of the earthed appliance to the earth terminal of the set.

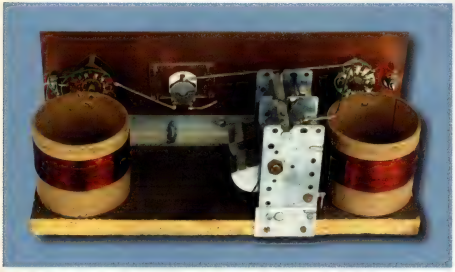
This provides a reasonable earth but make sure the appliance has a relatively short lead to the power point.

Do not attempt to obtain a mains earth in any other way - the possibility of making a fatal mistake is much too great.

A good antenna

The old saying of "the higher and longer the better" when referring to antennas for crystal sets and other low-performance sets is still true today.

If you live out on a farm, erecting an effective antenna is relatively easy. A good standby is the old standard in-



Provided it's fitted with a good aerial and earth, this simple "two circuit" crystal set is quite a good performer.

verted "L" antenna some 30 metres long across the top and 13 metres high. "Higher and longer" will capture even more signal and possibly also lightning, so lightning arresters are desirable on antennas of this size.

Most of us do not have the wide open spaces to install this type of broadcast receiving antenna so we have do the best we can with the available space. It's also necessary to comply with local council bylaws.

In most cases, any antenna that's erected will be a compromise between performance and available space. The installation must also be safe and must not be an eyesore to neighbours or others living on the premises.

It is possible to run an antenna (flat top section) around the yard, with one end attached to the chimney (if the house has one) or to a TV antenna mast – see Fig.3. Specialist TV antenna supply shops, such as Lacey's Australia in Frankston, Victoria, have a wide variety of TV antenna mounting masts, brackets and other items which can be used for this job.

A number of the advertisers in SILICON CHIP, such as Jaycar, Dick Smith Electronics and Altronics, also have a range of TV-antenna bits and pieces. Check out their catalogs and you should have little difficulty in choosing the necessary parts to make your antenna effective, safe and aesthetically pleasing.

Commonly, in the past where there was little space for an antenna, it was made to look something like a clothes line, as shown in Fig.3. This is an effective way of getting a considerable length of wire up into the air in a confined space. It may not be as effective as a long, straight run of wire but it is still quite good.

Regrettably, some people are not allowed to have any outside antenna

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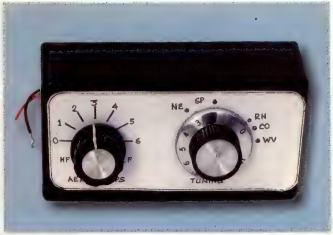

Above: this miniature 2-circuit crystal set uses all ferrite-cored coils and is quite a good performer. Its circuit is shown in Fig.5, for those who want to make their own. At left is an old ferrite-cored tuned circuit crystal set, complete with wooden case and a set of high-impedance headphones.

system at all (perhaps for "aesthetic" reasons). However, all is not lost as outside antenna systems can be erected at night by suitable mechanisms and pulled down after use. Some people have even disguised an antenna mast as a flag pole. A little ingenuity is sometimes needed here.

If that doesn't suit, an antenna in the ceiling space can be much better than nothing at all. There are a few provisos, however – the house must have a gable roof and the roofing must not be metallic. Nor should there be any metallic foil underneath the tiles (metal acts as a shield for radio signals).

To build a ceiling space antenna, install several folded lengths of insulated wire near the peak of the roof and bring one end down to where the receiver is located. Thirty metres of wire should give reasonable performance. It certainly won't be up to the standard of a high outside antenna but it's much better than nothing.

Antenna wire

An outside antenna lead can be made from single or multi-strand copper or galvanised iron wire. It can be insulated or bare but it must not too thin, otherwise it will break in the wind or if a bird flies into it. I use common gardening tie wire (available at hardware stores) of around 16 gauge – it's cheap and solders quite well.

If you use bare wire, it is necessary to also use egg insulators (available from stores selling electric fence components and major electronic stores) at the points where it is supported,. Alternatively, the polyproylene pipe used for gardening systems can be used in some situations.

The down lead to the receiver from the antenna should be run using insulated multi-strand cable, such as one half of twin-flex cable used on small electrical appliances.

Any joins in the antenna wire must be soldered. If they are not soldered, scratchy noises will be heard in the radio or variations in level will occur after only a few weeks. That's because the wires oxidise and intermittent good and bad contact between the joined wires will occur.

Finally, to alleviate any stress on the lead in, it should be attached to the antenna proper in a manner similar to that shown in one of the photos.

Optimising performance

A normal AM broadcast antenna is an aperiodic device, meaning that it is not tuned to any particular frequency. By contrast, if it were tuned to a specific frequency, the amount of signal picked up by the antenna would rise noticeably.

In other words, tuning the antenna system can greatly improve its performance and this can be done quite easily.

Fig.4 shows the details. First, obtain 150mm of 20mm-diameter PVC electrical conduit and wind about 180 turns of 0.5mm (24B&S) enamelled copper wire onto it, with tappings made at every 20 turns. The tappings can be made by inserting a match under a turn, winding some more turns on and then sliding the match further along as you progress, keeping each tapping point proud of the coil.

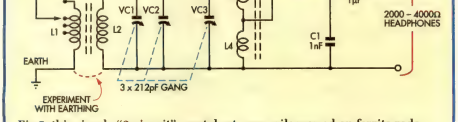

Fig.5: this simple "2-circuit" crystal set uses coils wound on ferrite rods. The constructional details are in the text.

One end of the finished coil is then wired in series with the antenna lead, while a "fly lead" fitted with a small alligator clip is soldered to the other end. This fly lead allows sections of the coil to be shorted out if necessary.

Alternatively, either the antenna or the receiver aerial lead can be terminated on one of the terminals along the coils, as shown in one of the photographs.

Once the coil is in place, it is then time to trial the tuner by sliding a 180mm-long (not critical) x 9mm-diameter ferrite rod into the coil and observing the results. Try different coil tappings until you get the nest performance.

Once the correct tapping is found for the coil, altering the position of the ferrite rod in the coil will peak the performance on any particular station. Note that this coil will also work with the average domestic receiver, although its performance at the low-frequency end of the dial can be unpredictable due to the way some aerial coils were designed. More turns may be required on the peaking coil in some cases.

Initially, the rough and ready method described above will give good results. However, it can all be made much tidier. Excess turns on the coil can be removed if desired and a more sophisticated method of adjusting the position of the ferrite rod inside the coil can be constructed – see Fig.4.

Jaycar Electronics can supply suitable ferrite rods (Cat. LF-1012) for an antenna tuner but loopstick antenna rods scrounged from defunct sets are also quite suitable - just remove the windings from the rod. If the rod has been broken and you have all the pieces, it is often possible to effectively rejoin them provided the breaks are clean and the two sides of a break mate without gaps. You can use Araldite or some other similar adhesive for this job.

Crystals sets & antenna tuners

On my own crystal sets, I can receive just one station without the antenna tuner. By contrast, if the antenna tuner is used, I can receive four stations, including a Melbourne station some 150km away! The tuning is also much sharper than normal and the aerial tapping is quite low on the coil.

Initially, however, I found that the crystal sets were not performing at all well, barely receiving the local station just 20km away. I tested the germanium diodes using the diode tester function on my digital multimeter and found that the forward voltage drop had increased from 0.2V to 0.8V, while the reverse voltage conduction point was down to 3V. The diodes were consigned to the rubbish bin and new ones installed.

The crystal sets in the photos belong to members of the local vintage radio club. Two are very nice looking sets and perform quite well. The small one in the jiffy box (130 x 65 x 40mm) is extremely interesting as it uses ferrite cores on all coils and a tapped antenna loading coil (possibly to resonate the antenna).

I have not heard this latter set in operation but have heard others claim that it is a particularly good performer. As a result, its circuit is enclosed for readers who may care to experiment - see Fig.5.

All the coils are wound using 0.5mm (approx.) enamelled copper wire. L1 and L2 are wound on the same piece of ferrite rod but at opposite ends of the rod which is around 50mm long. Coils L3 and L4 are wound on two ferrite rods, each around 30mm long.

The amount of coupling between L2 and L3/L4 is open to experimentation – around 50mm apart should give good results.

Summary

A high and long antenna coupled with a good earth system is important if worthwhile results are to be obtained from crystal sets and other low-performance sets. In some cases, it may also be necessary to tune the antenna to the frequency of the desired radio station (ie, by using an antenna tuner).

As for crystal sets, the best performing types are those using two tuned circuits – as in Fig.5. Also, it's necessary to use a germanium diode for the detector and a pair of high-impedance (2-4kΩ) headphones. **SC**

Photo Gallery: Tecnico Aristocrat Model 651 Radio

Built in 1946, the Tecnico Aristocrat featured a distinctive "mottled" bakelite cabinet. This cabinet was completely different to those used by other manufacturers, some of which were still using cabinets from their pre-war models.

The set pictured here is a 5-valve dual-wave radio with a 20cm (8-inch) permanent magnet speaker (loudspeakers of this size were rarely seen in mantel or table radio). A colourful badge and dial glass complete the attractive presentation.

The set was advertised as being available in various colours and Tecnico achieved this by painting over the bakelite. This particular unit has been fully restored by its owner, Maxwell Johnson, Kingston, Tasmania. (Photo: Ross Johnson).

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Upgrading the SC480 amplifier

With respect to your new SC480 amplifier modules, how can these be connected together or modified to produce 100W. Also, would there be any sound quality advantage in changing the 1µF bipolar input series capacitor to a metallised polypropylene type, as used in crossovers? (P. R., St Lucia, Qld).

● We actually went through the same process way back in February 1988 when we upgraded our original December 1987 design.

The process basically involves increasing the main supply rails to ±50V, changing the output transistors to MJ15003/MJ15004 (TO-3 types), Q1-Q3 to BC556, Q4 & Q5 to BF469 and Q6 to BF470 and increasing the power supply capacitor values and voltage ratings to 63V. Naturally a much bigger transformer is also required.

We think a better and more cost-effective approach would be to build the Plastic Power amplifier from the April 1996 issue. We can supply the issue for $8.80 including postage.

You could change the input capacitor to an MKT type but we very much doubt whether there would be any improvement.

Reproducing old wireless sound

I am a member of an amateur theatre company and we are planning to stage a comedy "Lend me a Tenor", set in Chicago in 1934. There are three or four occasions where the performer is supposed to be listening to the radio, to works by Giuseppe Verdi.

For effect, I'd like to try to approximate the type of reception people may have experienced at that time. I don't want the audience to 'hear' excerpts from Verdi's operas via a CD and a late 1990's full-range, 500W public address system in the theatre – that would be too much of an anachronism.

Clearly the radio systems were AM (ie, limited bandwidth and noisy). In addition to this, receivers were low-powered but with (relatively) efficient loudspeakers. The efficiency came at a cost, though – that of frequency response.

What would the frequency response of the recovered audio have been like? What sort of signal-to-noise ratio might have been expected? I have some ideas about the answers to these questions but am seeking your expert opinion.

I plan to record the relevant tracks, modify the 'system' frequency response to something similar to that you nominate and add appropriate amounts of both white and impulse noise. Hopefully the end product will have a big degree of realism. (R. W., via email).

● Your question is quite complex. In reality, the AM broadcast system was, and still is, capable of very good results. Today, with the very best receivers, you can get a result which is practically indistinguishable (for most listeners) from FM stereo.

In years past, the main limitations were the radio receivers but even the best of those could sound quite good. In reality, the frequency response from a good console radio (wireless!) could be up to 5kHz while the signal-to-noise ratio would be around 40-50dB or thereabouts. A good portion of the background noise would be hum. If you can get to a radio museum, have a listen for yourself.

However, there were other limitations on the sound quality. If it was a live broadcast you need to imitate the effects of the microphones and their placement (they did not have multiple microphones and multi-channel mixers). Some of the old style microphones are still available and sort after by groups who want to produce that "sound".

If the performance was recorded it would generally have been on 16-inch 78RPM transcription discs and these also had a sound all their own because the magnetic pickups of the day had quite a lumpy frequency response and recording equalisations were not standardised. The old turntables also suffered from wow and flutter and there was considerable surface noise, clicks and pops, etc.

To do what you ask and keep things simple, we would be inclined just to limit the frequency response to no more than 5kHz and just see what it

Tacho fix for positive chassis car

I've recently built the Digital Tacho from the April 2000 issue and have successfully connected it to my 1988 Ford Laser in which it appears to work exactly as described. My problem is that I actually want to connect it to my 1956 Austin A30 which has a positive chassis.

When I connect the coil to the tachometer, the numbers displayed are wrong. At idle it shows '000' when it is clearly doing about 1000 RPM. The numbers do increase with engine revs but don't appear to be stable (that is, they go up and down by several hundred while the engine is at a constant speed).

Do I need to do something clever to make this tachometer work correctly with this car? The documentation makes no mention of cars with a positive earth but I can't imagine that I'm the first person to try this kit with that type of car. (R. S., via email).

● We do not think that the positive chassis is causing the erratic display reading. Try changing the 0.056µF capacitor at the ignition coil input to something smaller; 0.022µF (22nF) may be small enough for correct operation.

sounds like. The illusion would be helped by having the listener actually switch on a radio. You could also take it further and have the sound broadcast via an AM transmitter and then mike the sound from the radio (oops, we mean wireless!)

We described a low power AM transmitter in the January 1993 issue of SILICON CHIP.

Compatibility between DVD players and TVs

We have a Philips 26CE1991 television which when connected directly to the DVD player pulsates its picture light and dark. The DVD player has been checked by two service centres and seems to be OK.

Philips tell me that this TV is too old and we should simply buy a new one. Are there any mods that are known to overcome this problem or are we stuck with the Macrovision protection breaking through? (E. G., via email).

● Our information is that this set was made in 1991 by Sampo for Philips and was designed before Macrovision. It is therefore unable to cope with large chunks of signal being removed.

The only real cure is to build the Doctor Video kit from the April 2001 issue of SILICON CHIP. This copes well with Macrovision 1 & 2 but not Macrovision 3. Otherwise, the only solution is to buy a new set.

Upgrading the 24V/20A speed control

I recently assembled the 10A Motor Speed Control from the June 1997 issue of SILICON CHIP. I did it to teach myself more about DC motor control, as I have started working in the electric forklift servicing field. I increased the controller's capacity to 20A by installing the second Mosfet, as suggested in the kit instructions.

I would like to know how to modify the kit to handle the much higher currents found in DC electric machines, from a hundred and possibly up to 1000A and also to handle higher voltages such as 24V and 48V. Would it simply be a matter of continuing to add Mosfets in parallel or would the circuit driving the Mosfets need to be upgraded as well.

Also the instructions said the controller could be used to run 12V motors in 24V systems. Could it be used to run 24V components in 48V machines? (P. R., Jerrambombera, NSW).

● While in theory, the specified Mosfets could run with supply voltages up to 48V, it would not be good practice. We would prefer to see much more rugged Mosfets used, with much higher voltage ratings.

Running at much higher currents is also possible in theory but in practice, the very small PC board would mean that the extra Mosfets would have to be off-board and that can lead to problems; you need individual gate drive to each Mosfet and heavy conductors for the commoned Drain and Source connections.

In addition to the above, the 12V regulator feeding the TL494 has an absolute maximum input voltage of 35V, so you would need to add a preregulator circuit to ensure that this rating was not exceeded, if you wanted to run the whole circuit at 48V. In summary, the practical limit of the circuit is 24V and not a lot more than 20A.

24V needed for Mustang A/C

I am working on the air-conditioning for an old Ford Mustang and I need a 12V-24V step-up inverter to operate the clutch solenoid. Can you tell me if there is one available or if you have described a suitable circuit? (K. W., Nevertire, NSW).

● The only 12V-24V inverter that we know of is a small one from Jaycar (Cat AA-0264). This is said to double the input voltage (from 6V to 12V or 12V to 24V) and has a maximum output current of 2A; we assume this is at 12V out.

This may not be enough to pull in the solenoid but should be enough to maintain it in the closed position once it has operated. You may need to connect a large electrolytic capacitor across the output to provide the pull-in current. We suggest you try a value of at least 10,000µF at 25V or higher.

Delay for Battery Guardian

I have a quick comment/observation about the Battery Guardian published in the May 2002 issue of SILICON CHIP. I like the solid state and low current draw but I am having problems with it dropping out on start-up, particularly if the load is more than 10A or so.

Would it be possible to delay the voltage sensing for about five seconds so that it does not detect the initial load droop? (J. H., via email).

● The solution is to increase the 10µF capacitor associated with ZD2 to 100µF. This will filter out the voltage droop when a 10A load is applied.

How to control radiator cooling fans

I'm intending to use one of your temperature switch kits to control a pair of cooling fans which I want to fit to an old car of mine. My ignorance of thermocouples prompts me to seek advice from you before I embark on this project. Jaycar's advert and photograph shows an already constructed kit which is supplied with an NTC thermocouple which, by observation of the picture, is the small component on one corner of the board looking like a tag tantalum capacitor.

Would it be possible to use a wire type "K" thermocouple as I reckon it would need to be able to sense the temperature of the engine cooling water direct. I think I could encase the business end of one of these in a metal device to protect it from getting wet and then the casing complete with protected thermocouple could be installed for immersion in the cooling water. Is all that practical and if so, would I need to make any alterations? (P. W., via email).

● The kit you refer to has not been published in SILICON CHIP. The fact that it uses a thermistor means that it will not have the necessary high gain circuitry to work with a thermocouple. In fact, we would not recommend this kit for control of fans in a car.

We would suggest you consider the thermostatic switch for car radiator fans published in March 1992. We can supply this issue for $8.80 including postage.

Hang problem with mixture meter

I recently purchased and built the Digital Fuel Mixture Meter, as published in the September & October 2000 issues. It has a problem in which at power-up, it will sit for a few minutes, reading (L) for low and no matter what input level you put into it (0-1V), it will hang. This problem often goes after two minutes but may remain in a hang state for longer.

It is not yet in a vehicle and is being fed constant 13.5V and a constant input at 0.5V. (F. N., via email).

● This is indeed an unusual problem. It is possibly caused by pin 4 of IC1 being open circuit, either within the IC socket or where soldered to the PC board.

Alternatively, the crystal may be a slow starter, causing the software to latch up as it will not be reset properly. Try using smaller value capacitors from the crystal to ground at pins 15 and 16. Values ranging from 10pF to 15pF should be suitable.

The other problem could be with the power supply you are using. If this supply rises slowly to 12V at switch-on, the circuit could exhibit the problem you experience. Try connecting the circuit to the power supply terminals after it is powered up.

Zero voltage switch for wall oven

Some 15 years ago I redesigned our kitchen wall oven to something akin to 'burst firing' electronic control of the heating elements. I used a combination of an Analog Devices AD595 Thermocouple Amplifier with a ramp-driven 14-pin CA3059 zero voltage switch IC to control a suitably-sized Triac. It has proved to be accurate to ±1° and quite reliable.

Recently though, the CA3059 failed and I have not been able to locate a replacement. Harris and then OnSemi manufactured them but discontinued about a year ago. I was wondering if you could help with the name of a supplier. (J. N., Tauranga, NZ).

● We do not know of a substitute for a CA3059 but if you want a zero voltage switching power control circuit, have a look at the Heat Controller published in the July 1998 issue. This used the readily available MOC3041 zero voltage switching Triac optocoupler.

We can supply the July 1998 issue for $10 including airmail postage.

Audio frequency power meter wanted

I am in need of an audio frequency power meter. I'm thinking of something that reads in dB and mV and takes an electrical input (rather than including a microphone). It needs to be accurate across the audio spectrum.

While the option of a microphone input would be nice, this is a considerably harder proposition, since the characteristics of the microphone would have to be compensated for and accurate calibration would probably require specialist equipment. (A. M., via email).

● We have published two AC millivoltmeters which would suit your application, in August/September 1988 and October/November 1998. We can supply the 1998 back issues for $8.80 each, including postage and the 1988 articles as photostats, again for $8.80 each, including postage.

Braking system for a wheelchair

I am a Year 12 student starting my Major Design Project. My project is a wheeled walker for the disabled.

My current need is for a braking system and an easier way of going about it. I want to create a one-off braking system using electronics and two motors with a simple on/off sequence and a button on each handle to easily apply the brakes.

What do you suggest? (D. G., via email).

● We suggest you build a speed control with inbuilt braking. Have a look at the 50A speed control published in the May 2000 issue. We can supply this issue for $8.80, including postage.

Notes & Errata

RIAA Preamplifier, March 2002: the 10µF across the ±15V rails should be 35V not 16V.

Smart Card PIC Programmer Interface, February 2003: the clock connection from the card socket should go to pin 12 of the 18-pin socket, not pin 16.

PortaPAL Portable PA Amplifier, February and March 2003: there is a circuit error concerning both the microphone MIC1 and MIC2 inputs. The circuit shows two 10kΩ resistors in parallel connecting from pin 2 to ground whereas one of these resistors should connect to pin 3 instead. The PC board is correct. **SC**

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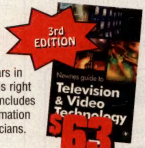

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